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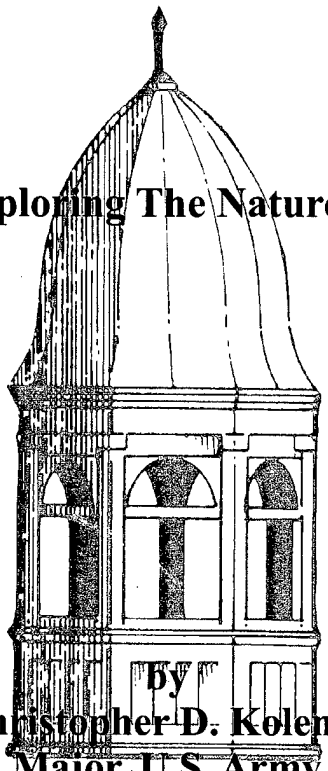
Uncertainty in War: Exploring The Nature Of Combat and Conflict



by
Christopher D. Kolenda
Major, U.S. Army

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U. S. Naval War College
Newport, Rhode Island

Uncertainty in War: Exploring the Nature of Combat and Conflict

By

Christopher D. Kolenda
Major, U.S. Army

This paper was completed as an independent research project in the Advanced Research Department, Center for Naval Warfare Studies, Naval War College. It is submitted to the faculty of the Naval War College in partial satisfaction of the academic requirements for the degree of Master of Arts in National Security and Strategic Studies. As an academic study completed under faculty guidance, the contents of this paper reflect the author's own personal views and conclusions, based on independent research and analysis. They do not necessarily reflect current official policy in any agency of the U.S. government.

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Chapter One

Introduction and Overview – Framing the Issue of Uncertainty

Challenging the Assumptions

A detailed examination of uncertainty in war has the potential to open new avenues of understanding about the nature of combat and conflict. No single study of uncertainty in war exists in the English language. Interestingly enough, there exists no vocabulary, no taxonomy, and no typology in military or civilian literature that adds coherence to uncertainty. While the concept has been mentioned in passing, the lack of systematic analysis has truncated our understanding. This study will challenge fundamentally many of our assumptions about war and the nature of combat and conflict. It should lead us to question how well we are preparing our soldiers, leaders and organizations for war in the future as well as the validity of current and proposed warfighting concepts. It will provide new insights into understanding wars in the past and into conceptualizing war in the future. It will, I hope, provoke more informed reflection and study of the subject.

Uncertainty is intrinsic to the human condition and to war. It exists and will continue to do so as long as individual human beings remain human, in the totality of meanings that description entails. It is part of our nature. It is part of the world in which we live and interact with other human beings. The best we can do is to try to understand and cope with it. This is not to say that we cannot reduce or bound some uncertainties,

only that we should exercise extreme caution before declaring anything that has to do with combat and conflict between human beings certain. This study seeks to understand why.

The purpose of this study is to explore the nature of uncertainty, how it manifests itself in war, and to suggest some ideas on how to cope with our own uncertainty and exploit that of the enemy. In so doing, it will bring the nature of combat and conflict into sharper focus. The critical questions I am exploring in this essay are 1) Is war uncertain and if so why? 2) What is uncertainty? 3) How does uncertainty manifest itself in war? 4) How can we most effectively cope with our own uncertainty and exploit that of the enemy?

This paper will open a window on the world of uncertainty. It will uncover avenues of understanding and inspire further explorations that will open additional pathways into this murky realm. It will also generate more informed thought on how we can cope with and exploit uncertainty. Such understanding has the potential to increase our effectiveness in the combat and conflict of war by an order of magnitude. It should stand as notes of both caution and opportunity in nearly every facet of policy and strategy.

Some Initial Thoughts

Uncertainty, like friction, is a phenomenon that makes real war different from war on paper. War and action in war often generate outcomes and consequences that defy the expectations of political and military leaders and their staffs, not to mention outside observers in the media and academia. A state goes to war with the expectation that it will

attain some political object. If combatants could reliably predict the costs and outcome of the war through some sort of wargame, the participants would be much better off settling the matter according to the game's results and saving the blood and treasure of their people. Unhappily, such is not the case. A state that goes to war with another believes it can win, that it can attain its object at acceptable cost. That states often fail to achieve all they hope in war stands as a testament to war's uncertain nature, outcomes, and consequences. Helmuth von Moltke's famous aphorisms, "no plan survives first contact," and "strategy is a series of stop-gaps" serve as further experiential insights that war on paper is different than real war. This study will help to explain why.

Perhaps the greatest misunderstanding about uncertainty is the common notion that it is primarily a matter of information, and that the two are inversely proportional.[1] Uncertainty, as we will see, is by no means reducible to information. Without question, some uncertainties, such as where the enemy and friendly forces are located, are related to information. But those uncertainties merely scratch the surface of the problem.

Uncertainty is human. Uncertainty deals with how we understand and interpret information: our biases, the heuristic devices we subconsciously employ, our personal emotions and baggage, our education, and our experiences. Our rationality is bounded. We see things through our own perceptual lenses and understand them using our own cognitive maps. In real life we see that intelligent people can look at the same set of information and come to completely opposite conclusions about it. Such disparity manifests itself everyday among normal people in differing political and religious philosophies, economic and social analyses, and assessments and opinions about ideas and events. As unique individuals we see the world differently than those around us,

sometimes in subtle, sometimes in radically different, ways. The meaning and significance of information and stimuli is, for better or worse, in the eye of the beholder.

Uncertainty manifests itself in decision-making because we understand and interpret the world in our own unique ways. We can react to the stimuli much differently than those around us. We make choices based on the salience of those impressions in our own minds. Moreover, there exist different processes, strategies, and influences from which we can choose, consciously or subconsciously, to make decisions. These different methods can lead to substantially different courses of action.

Even when we make a decision, there is no guarantee that it will be implemented as we envision. The unique nature of each organization generates uncertainties, particularly in war. Although one infantry platoon, for instance, should have the same capabilities and limitations as any other infantry platoon, factors such as the environment and context, leadership, training, discipline, individual and collective psychology, and cohesion intervene to make them decidedly different. Even more problematically, those same factors alter organizations over time, sometimes dramatically, sometimes subtly, texturing their nature and changing their capabilities and limitations. As we shall explore later, there is also no guarantee that a good decision will lead to a favorable outcome or that a poor decision will lead to a bad outcome.

Because the human factors of war manifest themselves in ways unique to the context, the seemingly logical and linear line between decision, action, and outcome is often a false expectation. Advances in the theories of nonlinear dynamics provide further insight that chaotic behavior and outcomes can be as normal as linear ones. Nonlinear systems generate outcomes that defy proportionality and additivity. The Doolittle Raid

on Japan in 1942, for instance, although it generated very little damage or had very few direct military effects, caused chaotic behaviors in the Japanese military and government that led to a variety of decisions that proved disastrous.[2] Conversely, history shows plenty of examples of engagements in which what was a mathematical certainty on paper when calculating linear correlation of force equations actually resulted in outcomes radically different, and initiated chains of events that unraveled the efforts of the stronger combatant. Despite our best efforts to model combat outcomes based on correlations of forces and means measurements, and to script the events in war according to mathematical probability, the reality of nonlinearity intervenes, creating uncertainties unrecognized by linear equations.

The interactive nature of war creates myriad uncertainties that few have sought to comprehend. War is a series of interactions: interactions with ourselves, with our organizations, with the enemy, and with the external environment. As the magnitude and complexity of these interactions grow arithmetically, the range of possible results grows geometrically making certainty in the outcomes of war problematic at best. The fields of game theory, economics, and evolutionary biology help illuminate how the interactions generate complex causality and produce outcomes that, although seen as logical in hindsight, are far from evident when looking forward. Exploring the nature and complexity of interactions in war lends further insight into why discontinuities exist between perception and reality and between decision, action, and outcome.

In short, the human, nonlinear, and interactive natures of war generate uncertainty. Information is part of the problem, but only a small part. Recognizing the

challenge of uncertainty will enable us to develop meaningful methods to cope with our own uncertainties and exploit those of the enemy.

Uncertainty and the Information Revolution: History versus Technology

This study of uncertainty comes at a critical time for the armed forces. The conceptual ambiguity that has surrounded uncertainty has led, in part, to a very intense debate concerning the so-called Revolution in Military Affairs (RMA) and the future direction of the military. Much of the discussion revolves around the nature of information technology (IT) and its impact on uncertainty.

Advocates of the IT-RMA argue that the global information grid will enable us to realize the dream of Sun-Tzu: "Know the enemy and yourself; in a hundred battles you will never be in peril."[3] By harnessing the power of the microchip and achieving information dominance over the battlespace, we can know the enemy with such fidelity and precision that we can eliminate uncertainty as a factor in war. As retired Admiral Bill Owens in his book *Lifting the Fog* argues, "This new revolution challenges the hoary dictums about the fog and friction of war, and all the tactics, operational concepts, and doctrine pertaining to them."[4] In a similar vein, the authors of Network-Centric Warfare suggest that while predicting human and organizational behavior will remain "beyond the state of the art," improved battlespace awareness "certainly reduces uncertainty in a meaningful way."[5] To paraphrase Nietzsche, Clausewitz is dead (or barely breathing), and so is the paradigm of uncertainty as a defining characteristic of war.

The RMA advocates are not without their critics. Historian Williamson Murray asserts, "Those who argue for a technological view of future war clearly believe that

history is irrelevant ... 3000 years of history underline that fog, friction, ambiguity, and uncertainty have always formed the underlying topography of war."[6] Retired Lieutenant General Paul Van Riper (USMC), in his testimony to Congress on March 20, 2001, argued that we should not uncritically accept the promises of RMA advocates about lifting the fog of war: "There will always be uncertainty on the battlefield."[7] Claiming that war is a contest of will between two opponents, skeptics of the IT-RMA thesis believe that the essential human nature of war remains unchanged. Clausewitz, and his "hoary dictums" are alive and well.

The RMA skeptics, however, have failed to define uncertainty and articulate why it is ever-present. While uncertainty has indeed characterized war for the past 3000 years, that argument is no guarantee that future war will be defined that way as well. After all, 3000 years of warfare indicated that we could not attack an enemy from the air, that we could not "see" enemy formations over vast distances and despite terrain, and that we could not destroy the planet with nuclear weapons. All that has changed in the past century. Framed in that manner, the simple appeal to history falls flat as a critique of the IT-RMA.

Likewise, merely restating the Clausewitzian argument that uncertainty is a defining characteristic of war does not invalidate the IT-RMA argument. RMA advocates, in essence, question the validity of Clausewitz. Arguing that "if Clausewitz said uncertainty is ever-present then it must be true" is about as convincing to IT-RMA advocates as invoking Karl Marx in a discussion with a market capitalist. If we can see the enemy in the battlespace with clarity, they assert, we have indeed penetrated the fog of war. Perhaps aberrant human behavior and decisions will offer a degree of uncertainty

in terms of predictive analysis, but because we can see immediately the physical results of the behavior and decisions, the uncertain nature of the human factor is irrelevant. The "omniscient view of the battlefield"[8] that is now possible removes uncertainty as a meaningful problem in war, at least from the extreme IT-RMA perspective.

The manner in which one side characterizes the other is indicative of the intensity of the debate. Skeptics of the RMA charge that its advocates believe that history is irrelevant and will propel the US Armed Forces, eyes-wide-shut, into a dogmatic and dangerous faith in certainty and precision weaponry that will doom it to "expensive irrelevance."[9] RMA advocates, meanwhile, dismiss skeptics as reactionaries, products of an inherent military conservatism that are smug and afraid to question conventional wisdom, and "impediments to change."[10] As some observers have argued, "In an important sense ... US military policy remains imprisoned in an unresolved dialectic between history and technology, between those for whom the past is prologue and those for whom it is irrelevant."[11]

Resolving the Dialectic

Such intense, heated debates between groups of intelligent, experienced, and well-meaning people generally result from flawed assumptions or incongruities at the root of each position. Removing the problematic assumption or conceptual ambiguity often results in a synthesis in which arguments from each side can be reconciled and the intellectual energies can be channeled into more productive directions. In other words, conceptual clarity of a foundational issue can "resolve the dialectic."

That is the case here with the concept of uncertainty. RMA advocates believe that IT can remove uncertainty; that omniscient battlespace awareness of friendly and enemy forces will dissipate the fog of war and enable US forces to exist in a frictionless environment. Skeptics merely claim uncertainty is ever-present, and thus that the IT-RMA is overstated and dangerous.[12] They make the argument, however, without ever defining exactly what uncertainty is and what we are uncertain about in war. Adding conceptual clarity has the potential to reconcile the two sides of the debate, and to bring history and technology together in a meaningful, forward-looking, and synergistic relationship.

A better understanding of uncertainty will provide more clarity into the nature of combat and conflict in war. Armed with understanding, we can more meaningfully discuss how we can cope with uncertainty and exploit that of the enemy. The real potential of information technology, in the hands of wise leaders and high-performing organizations armed with sound warfighting concepts, is there rather than in a quixotic and misguided quest to eliminate uncertainty.

Uncertainty: A Brief Description and Methodology

I will use the term uncertainty in a broad and descriptive sense. At the macro level, the fact that war on paper differs from real war suggests the existence of uncertainty: if we work backward from the fact that real war does not conform to plans and expectations, we must admit uncertainty as we work forward. The discontinuities between prediction in war and outcome imply the existence of uncertainty. In each case

factors intervene in each unique situation to confound the neat strictures of theory, linear logic, mathematical probability, and prediction. As we probe deeper into why war evidences significant discontinuities between expectations and outcomes, we find human factors at work, as well as the existence of nonlinearity and the complexity of interaction. As the human, nonlinear, and interactive components iterate in unique combinations they generate further uncertainties. Thus, there are internal uncertainties that interact with external uncertainties to produce uncertain outcomes. Uncertainty is intrinsic to war. It encapsulates the conscious, sub-conscious, and unconscious manifestations of the gulfs between perception and reality and between prediction and outcome that make real war different than war in the abstract.

To better understand the concept of uncertainty, I will begin with a discussion of Clausewitz's notion of uncertainty in *On War*. Clausewitz is the only military theorist to deal with uncertainty in a meaningful, albeit fragmented, way, so his ideas deserve exploration for both their insights and their limitations. Next I will offer a "General Concept of Uncertainty" that will develop a vocabulary and taxonomy. After establishing the intellectual framework, I will explore the human, nonlinear, and interactive dimensions of war to open a window on the world of uncertainty and bring the concept into sharper focus. Last, I will suggest ideas on how to cope with and exploit uncertainty.

To explain uncertainty I will use an interdisciplinary approach. Relevant theories and studies from the political, behavioral, and social sciences, economics, biology, and mathematics, leavened with examples from history will aid our understanding. Of course dangers in such an approach exist. A seminal problem for many military theorists is that

they uncritically accept a few ideas from which they form their theories, mine history for examples that support their assertions, and then attempt to argue that their theory is of universal, predictive value.

My approach differs substantially. Uncertainty is ever-present in war, but how it manifests itself is as unique as the nature of each war, each battle, and each conflict itself. Thus, rather than mining theory and history to offer a rigid prescription for how uncertainty will manifest itself in any and every war, I will employ theory and history critically to show why and how uncertainty can manifest itself.[13] In short, I will remain in the realm of the possible and the real rather than in the realm of the universal and abstract.

Chapter Two

Sun-Tzu and Clausewitz on Uncertainty

The problem of uncertainty, with few exceptions, has escaped the attention of the great military theorists. Even the explicit treatments of the subject by those few have been superficial at best. This chapter analyzes in detail concept of uncertainty in war crafted by one of those thinkers, Carl von Clausewitz. The Prussian, without the benefits of studies we have today, began to uncover a concept of uncertainty that will provide an interesting foundation for our further exploration.

Before dissecting Clausewitz's thoughts on the subject, however, it is useful to explore briefly and critically Sun-Tzu's ideas. The earlier theorist also discussed uncertainty, but from a completely different vantage point. It is important to understand that perspective in order to illustrate where his ideas differ from Clausewitz's and to understand why. Interestingly enough, despite the myriad contrasts between the two thinkers, they have important commonalities on the subject of uncertainty. After analyzing briefly the ideas of Sun-Tzu, we will examine in detail Clausewitz's "unfinished" concept of uncertainty. What will become evident is that the treatment of uncertainty implicit in Clausewitz opens interesting avenues of analysis that will allow us to sharpen our understanding of war.

Sun-Tzu: Uncertainty in the Art of War

The late Michael Handel has compiled the best comparison of thoughts on uncertainty among military thinkers in his last work, *Masters of War*.[1] A student of strategy and intelligence, Handel situates his discussion of uncertainty inside a subsection on "Intelligence, Friction, and Uncertainty" within a chapter on "Deception, Surprise, and Intelligence." Handel's focus is on intelligence in war so his discussion of uncertainty is limited to the role it plays within that rubric.

Handel's most significant counterpoise is that between Sun-Tzu and Clausewitz. The former is optimistic about the reliability of information and intelligence in war. The Prussian, on the other hand, is skeptical at best. Oftentimes he is downright pessimistic. The reliability of intelligence and the ability of the commander to make estimates about the nature of the war and the enemy and friendly forces are key requirements, in Sun-Tzu's view, for success. His *Art of War* is a manual for how to win wars. Clausewitz's *On War*, by contrast, is a tome about the nature of war. The subtle difference is absolutely critical, particularly in helping us find and understand the contradictions in Sun-Tzu regarding uncertainty.

The Art of War by Sun-Tzu is a "sales pitch" to ancient Chinese warlords. Sun Tzu used *The Art of War* to convince Chinese warlords to employ him and his ideas in their quest for survival and hegemony in the Era of Warring States (403-221 BC) in classical China.[2] Understanding this context is crucial. Sun-Tzu's optimism about the roles of intelligence and deception in successful prosecution of war becomes quite evident when viewed in this light.

His familiar dictum, "Know the enemy and know yourself; in a hundred battles you will never be in peril,"[3] was central to his thesis on war; indeed it has become a foundational aphorism to IT-RMA advocates. Sun-Tzu counseled that we must understand war according to five fundamental factors: moral influence, weather, terrain, command, and doctrine.[4] Armed with an understanding of the five factors as they pertain to enemy and friendly forces, Sun-Tzu advocated the systematic employment of intelligence collection assets, primarily spies, to gain an understanding of the enemy's strategy.[5] "Thus, what is of supreme importance in war is to attack the enemy's strategy ... [Li Ch'uan] Attack plans at their inception ... The supreme excellence in war is to attack the enemy's plans."[6] At the same time that spies were collecting intelligence on the enemy's strategy and plans, the commander would estimate the situation based on the five factors and would employ reconnaissance to ascertain information on the enemy.[7]

Conversely, Sun-Tzu counseled the wisdom of deception and secrecy to keep friendly strategies, plans, and dispositions away from the enemy. He advocated being unpredictable and opaque by "responding to circumstances in an infinite variety of ways," by keeping plans secret "so that people have no knowledge of what he is doing."[8] He wanted to deceive the enemy by creating dispositions "without ascertainable shape."[9] Secrecy, unpredictability, and deception, when combined with knowledge of the enemy and himself, were the foundations for victory. In fact, such an imbalance would enable the general to reveal the acme of skill: "to subdue the enemy without fighting" and "to take All-under-Heaven intact."[10]

According to Handel, Sun-Tzu "points out the importance of what is termed, in today's intelligence jargon, net assessment" – the comparative evaluation of strengths and

weaknesses of each side.[11] He also emphasizes the criticalities of predictive analysis and operational security in knowing the enemy and yourself and preventing the enemy from doing the same. Sun-Tzu was confident that he could predict the outcome of any given war based on the quality of estimates and analysis by each side.[12] "There is much less room in his theory of war for uncertainty, friction, and chance," Handel asserts, "His logic is simple and linear; good intelligence forms the basis for better planning, and the possibility of controlling events on the battlefield allows the implementation of those plans, culminating in the achievement of victory."[13]

For Sun-Tzu, therefore, uncertainty was a problem to be overcome and an opportunity to be created and exploited. Overcoming uncertainty was seemingly a matter of effort – employ strategic and tactical reconnaissance, discover the enemy's plans and dispositions, estimate and understand the situation according to the five factors, and do it more effectively than the enemy, and your victory will be certain. At the same time, by the use of deception, secrecy, and unpredictability, the savvy general could create uncertainty for the enemy commander and then exploit opportunities as the situation developed and the enemy commander began making mistakes on account of being fooled, deceived, and surprised. "Thus, one able to gain the victory by modifying his tactics in accordance with the enemy situation may be said to be divine."[14]

There exist, however, striking caveats to Sun-Tzu's apparent optimism that seem to be overlooked by many scholars and IT-RMA enthusiasts. As he admitted, "And as water has no constant form, there are in war no constant conditions."[15] In such a fluid and uncertain environment, even the best of estimates and predictions must be less than perfect. "Therefore a skilled commander seeks victory from the situation and does not

demand it from his subordinates."[16] The fact that one cannot, by a set of prescriptions and fixed rules, arrive at a recipe for victory was obvious to Sun-Tzu.[17] While the wise commander can read a situation and make decisions that result in victory, war's inherent uncertainty requires intellectual agility rather than slavish adherence to formula.

War's uncertainty, for Sun-Tzu, was a product primarily of the enemy's free will. Soon after arguing that knowing the enemy and yourself will prevent peril, he begins a discussion of invincibility and vulnerability. "Invincibility," he argues, "depends on one's self; the enemy's vulnerability depends on him. It follows that those skilled in war can make themselves invincible but cannot cause an enemy to be certainly vulnerable. [Mei Yao-ch'en] That which depends on me, I can do; that which depends on the enemy cannot be certain. Therefore it is said that one may know how to win, but cannot necessarily do so."[18] Sun-Tzu then spends the remainder of the chapter on "Dispositions" discussing how to win. What these comments suggest is that Sun-Tzu was far less optimistic about the certainty of victory than some scholars believe. He seems to have appreciated in particular the significance of the uncertainty generated by the free will of the enemy.

This appreciation of uncertainty led to his focus on recognizing and exploiting opportunity rather than in creating specific prescriptions for victory. Indeed, while he did claim that he could predict the outcome of a war from the quality of the estimates, he stopped short of saying that information – knowing the enemy and yourself – would lead to victory. He claimed instead the negative: that such knowledge would only prevent peril. The nature of the commanders, the armies, the plans, and the situation determined whether victory would be won. Mastery of the situation, therefore, is most important.

Information is only a part of the greater whole. Far from having little room for uncertainty, Sun-Tzu's theory of war depends upon it.

Sun-Tzu's concept of uncertainty, particularly the ability of a commander to overcome and exploit it, is inextricably linked with his ideas on how to win war. His discussion of the nature of war and the nature of uncertainty, however, lacks development. He does not discuss the human problems of perception. He fails to address how the interaction between opposing forces can create outcomes that defy predictability. He is less interested in exploring the nature of war and the individuals that fight in it than he is in discussing how to prevent failure and achieve victory in the dynamic and deadly context of the Era of Warring States.

Clausewitz's Unfinished Concept of Uncertainty

By contrast, Carl von Clausewitz, the Prussian military theorist and author of *On War*, is more interested in "the nature of war." He is a thinker trying to understand his own experience in the Napoleonic war and to put his thoughts into some comprehensible shape to further the understanding of war.[19] As one observer notes, "Clausewitz's ambitious goal for *On War* was that it help educate the next generation of military leaders by providing a theory of war expressive of war's complex reality, not ignoring but indeed emphasizing the uncontrollable elements in war."[20] Thus, concepts such as friction, fog, chance, and uncertainty are not at all taboo for the Prussian as they were for Sun-Tzu. Clausewitz is comfortable intellectually in chaos and ambiguity; that comfort reflects the challenging nature of his text, which is in turn a reflection of his understanding of the

nature of war. *On War* is a maelstrom of ideas, concepts, metaphors, and arguments, sometimes in concert, sometimes in contradiction, each of which has important but insufficient explanatory value, all competing for hegemony in the mind of Clausewitz. *On War* is a struggle. It is a search for balance and understanding through creative tension. The book, unfortunately, is an unfinished product.[21]

Importantly, however, Clausewitz explored the concept of uncertainty in some depth. As Michael Handel argues, the uncertain nature of war was, after the centrality of politics in war, his second most important group of ideas. For Clausewitz, the essence of war was its uncertainty, and "while the majority of those writing on the subject of war seek clarity and positive guidance for action, Clausewitz concluded that the best way to succeed in war was through comprehension of its uncertain nature."[22]

His ideas on the subject, to use one of the author's own terms, were largely a "formless mass," and seem to have coalesced in his mind late in life. By that time a number of concepts had matured for Clausewitz, among them the ideas of genius, friction, chance, and the dual nature of war.[23] As these concepts grew in importance, so did his conviction that war on paper differed fundamentally from real war: "But move from the abstract to the real world, and the whole thing looks different. In the abstract world, optimism was all-powerful and forced us to assume that both parties to the conflict not only sought perfection but attained it."[24] In the real world such "perfection" was unattainable, and Clausewitz explored the myriad reasons why in the first chapter of Book I.

It is useful, therefore, to provide some analytical structure to Clausewitzian uncertainty. Perhaps the simplest way is to examine it from the perspective of three of

his core, interrelated, concepts: rationality, friction, and interaction. We begin by highlighting some of the confusion about Clausewitz's own ideas about uncertainty in *On War* and address some common misperceptions in recent scholarship. We then examine Clausewitz's unfinished concept of uncertainty using the three core concepts.[25] Finally, we discuss some limitations to Clausewitz's ideas on uncertainty.

Ambiguity and Misapprehension

Textual Ambiguity

Real war differs from war on paper, according to Clausewitz, and this divergence creates uncertainty on a variety of levels. He failed, however, to establish a coherent concept of uncertainty to rival and complement that of friction. As a result, the criticality of uncertainty, although arguably central to his understanding of war, has been obscured, marginalized, and overlooked by most scholars.

Part of the problem is that Clausewitz was far from precise in his own mind about uncertainty. His own "friction" and "fog" are reflected in the text. As one scholar has noted, "Sometimes Clausewitz separates chance and uncertainty, sometimes he confounds them, and he often imbeds them in the context of other issues."[26] He recognized uncertainty as pervasive, but never developed it with conceptual clarity. "War is the realm of uncertainty," he wrote in his chapter on "Military Genius."[27] In the same section he also wrote that war was the realm of danger, physical exertion, suffering, and chance. Later in the chapter he argued that danger, exertion, uncertainty, and chance were the four elements that make up the "climate" of war. He regarded them as

"impeding elements,"[28] linking them with friction. This "tremendous friction," he suggests, is "everywhere in contact with chance," thus rendering war unpredictable.[29]

In the resulting barrage of mixed metaphors, confused taxonomies, and haphazardly linked and decoupled concepts in the span of two critical chapters (Military Genius and Friction), Clausewitz revealed that he was not clear in his own mind about how these concepts relate to one another. The concept of uncertainty is particularly imprecise and muddled. He did, nevertheless, open an exploration of uncertainty at a broad and general level. His "unfinished concept" of uncertainty was woven, both explicitly and implicitly, throughout the fabric of *On War*. The problem, in fact, was so daunting for Clausewitz, that he invented the concept "military genius" as the only reliable coping mechanism for the friction and uncertainty of war.

Common Misperceptions: Uncertainty versus Intelligence

Clausewitz's concept of uncertainty has been generally coupled with unreliable intelligence. To be sure, Clausewitz's own experience in war cautioned him against placing much faith in information gathered on the enemy in the heat of battle. Inaccurate reports and poor assessments indeed compounded the problem of uncertainty in combat. The reliability of information, however, formed only a minor part of Clausewitz's concept.

That being said, even the most sophisticated of Clausewitz scholars, Michael Handel, tended to reduce uncertainty to the reliability of information. Handel concluded that "... the role of friction and uncertainty in war – although always significant – began

to diminish in modern wars with the advent of real-time communications, in which more reliable intelligence and information can be transmitted and received...."[30]

Given the primacy he places on intelligence, Handel filters his discussion of uncertainty through that lens as he contrasts the thoughts of Sun-Tzu and Clausewitz. Whereas Sun-Tzu argued for the criticality of gathering intelligence on the enemy as a key to victory, Clausewitz by contrast emphasized the problem of friction: "The difficulty of accurate recognition constitutes one of the most serious sources of friction in war, by making things appear entirely different from what one had expected."[31] Where Sun-Tzu placed almost uncritical faith in the reliability of intelligence, Clausewitz's experience cautioned him to remain skeptical: "Since all information and assumptions are open to doubt, and with chance working everywhere, the commander continually finds that things are not as he expected."[32] Information, he surmised, can be more than doubtful; it can be unreliable and downright incorrect.

> If we consider the actual basis of this information, how unreliable and transient it is, we soon realize that war is a flimsy structure that can easily collapse and bury us in its ruins.... Many intelligence reports in war are contradictory; even more are false, and most are uncertain.... In short, most intelligence is false, and the effect of fear is to multiply lies and inaccuracies.[33]

After contrasting Sun-Tzu's optimism with Clausewitz's skepticism about intelligence, Handel couples it with uncertainty. "With uncertainty [that is, lack of reliable intelligence] in the one scale, courage and self-confidence must be thrown into the other to correct the balance."[34] The parenthetical is Handel's insertion into a statement by Clausewitz, but it is inappropriate given the context of the argument. Clausewitz, at that point in the text, was discussing "Modifications in Practice" – why war does not attain its abstract "absolute." Within that discussion, Clausewitz had been exploring chance, the

idea of war as a gamble, and human nature. He argued how the human intellect, while longing for clarity and certainty, was fascinated by uncertainty. He postulated the role of the moral forces of war in creating uncertainty. Not once in that section or the previous several ones did he mention intelligence or information.

Clausewitz was interested in something far more sublime – the role of human nature in war.[35] Imperfect knowledge, a much larger problem than "unreliable intelligence" for Clausewitz, was but one of many factors that "modified" war in practice, making it different than war in the abstract. To be sure, Clausewitz's concept of uncertainty was more substantial than unreliable information and intelligence.

Rationality

Clausewitz's unfinished concept of uncertainty necessarily begins with the notion of rationality. Clausewitz explored rationality on two related levels. At one level, war was governed by political rationality. War is fought for some political purpose. Politics provides war its "logic" and "reason." The second level was quite subtle: the problem of what has come to be known in modern times as bounded rationality.

Human logic, he was well aware, does not attain objective rationality. As Plato argued in the Myth of the Cave, human beings do not see things the way they really are; they see instead shadows of reality on the walls of the cave. Our rationality, in a sense, is bounded. We apprehend meaning in the world in unique ways and draw conclusions from the impressions we make.

It is our very nature as human beings that at once makes war both possible and unpredictable. In war, human beings interact in a deadly struggle. The results defy the prescriptions of linear logic and mathematical correlation. Passions, virtues, misapprehensions, impressions, judgments, and mistakes are parts of the intractable human dimension of war.

Bounded rationality is the first conceptual framework for Clausewitz that illustrates war's uncertain nature. It informs why states go to war in the first place and the nature of combatants that fight in it. Human rationality, as we shall see, also generates friction and shapes interaction in war.

Rationality and Judgment: Abstract versus Real War

At the broad conceptual level, Clausewitz begins by making the distinction between war in the abstract and real worlds. He spends the first five sections of Book One, Chapter One, defining war and describing it in its abstract and absolute form. Absolute war, as Clausewitz conceived it, would be "prefect" in that each side would maximize the use of force to "disarm" the enemy in a fixed-sum conflict with the total means at his disposal.[36] Bent on war, each side would increase its intensity to the extreme until war became absolute.[37]

War, however, never reaches its absolute, or "perfect," form.[38] Clausewitz begins a series of "Modifications in Practice" that bring the practice of war down from the realms of "logical fantasy" and into the real world. These "modifications" carry with them myriad uncertainties. He explains that war in real life is a "series of actions

obeying its own peculiar laws" that requires "judgment" to determine the amount of effort that should be made in the war. Part of that judgment is based on an "estimate" of the situation given what one knows about the enemy (intelligence) and how the laws of probability help deduce the enemy's likely course.[39]

Judgment determines the amount of effort that each combatant will make given the value of the political object.[40] Political judgment prevents war from becoming absolute because political demands can alter the timing of war, interrupt its progress, or stop it altogether. The same judgment that led to the decision to go to war in the first place should establish the limits and boundaries within which the war will be fought.

The judgment of military leaders can also prevent war from attaining its logical abstraction. Commanders determine when to attack or defend, and when to continue action or interrupt it. Such judgments are based on the commander's knowledge of the situation, which Clausewitz describes as, in itself, "imperfect." "The only situation a commander can know fully is his own; his opponent's he can know only from unreliable intelligence. His evaluation, therefore, may be mistaken and can lead him to suppose the initiative lies with the enemy when it in fact remains with him."[41]

Imperfect knowledge is in part a function of "unreliable intelligence," but it is primarily a function of "mistaken evaluation" and "faulty appreciation." It is an expression of bounded rationality. As we will discuss later, Clausewitz regarded information, be it accurate, inaccurate, or ambiguous, as a condition of the battlefield. The commander's judgment, he believed, was the critical factor. Human judgment brings war in practice down from the level of abstraction into the realm of the real. In sum,

political and military judgment, at one level, modifies war in practice; at another level the reality of imperfect judgment makes war an uncertain endeavor.

At the broad, conceptual level dicey factors such as human rationality distinguish war in the real world from war in the abstract. In the abstract sense, war is a matter of mathematical probabilities that would lend predictability and certainty to the outcome from the outset. While Clausewitz makes the case that absolute war exists only in the abstract world, an equally persuasive case can be made that mathematical certainty would make the entire notion of going to war absurd. The side on the losing end of the probability calculation would logically try to make the best deal possible to avoid war. Only if we remove the concept of logic would absolute war ever become a reality. Uncertainty, however, makes a favorable outcome in war seem like a rational possibility. Indeed one might argue that it is the factor that makes war possible and thinkable in the first place. Uncertainty is thus central to Clausewitz's distinction between the abstract and the real.

Nature of Combatants in War

The nature of combatants in war provides further challenges to objective rationality. Clausewitz highlights "moral qualities" and "psychological forces" that texture the subjective nature of war and make it an even greater "gamble."[42] The art of war, he tells us, "must also take the human factor into account.... The art of war deals with living and with moral forces. Consequently, it cannot attain the absolute, or certainty; it must always leave a margin for uncertainty, in the greatest things as much as

in the smallest." Because of these unpredictable human factors, "absolute, so-called mathematical, factors never find a firm basis in military calculations."[43] War, as a result, is not simply a matter of probabilities.

Clausewitz created the triangle and trinity to conceptualize the nature of combatants and illustrate the potentially unstable system in which they exist.

> War is more than a true chameleon that slightly adapts its characteristics to the given case. As a total phenomenon its dominant tendencies always make war a paradoxical trinity – composed of primordial violence, hatred, and enmity, which are to be regarded as a blind natural force; of the play of chance and probability within which the creative spirit is free to roam; and of its element of subordination, as an instrument of policy, which makes it subject to reason alone.
>
> The first of these three aspects mainly concerns the people; the second the commander and his army; the third the government. The passions that are to be kindled in war must already be inherent in the people; the scope which the play of courage and talent will enjoy in the realm of probability and chance depends on the particular character of the commander and the army; but the political aims are the business of government alone.[44]

The triangle consists of the people, the army, and the government; the trinity is made up of passion, chance and probability, and reason.[45] To understand war, Clausewitz asserts, one must understand the three tendencies in the remarkable trinity. A proper theory of war maintains a balance between them, like "an object suspended between three magnets."[46]

In war, therefore, combatants must sustain balance. Reason, which articulates the political aim of the war, is the purview of the government and must control, direct, and guide the passions of the people of the state as well as the application of military force toward attainment of the political object. The commander, through the creative application of force in the context of mathematical probabilities and uncontrollable chance, seeks to achieve the political aims of the government and also helps to sustain the

support and passions of the people by winning on the battlefield. The passions of the people, meanwhile, inform and provide context for political calculation and the sustainment and support of military activity.

Imbalance in the system could bring chaos and defeat.[47] Lack of political direction could result in the inappropriate use of military force and failure to sustain the support of the people. Incompetence or poor performance in the military can threaten attainment of the political object and erode the enthusiasm of the people. Uncontrolled or absent passion can lead to inappropriate political decisions and failure to sustain military activity.

The notion of a combatant at war as an object suspended between three magnets highlights the uncertainty intrinsic in the system. As one scholar notes, "If war is one part passion, one part chance [and probability], and one part reason, then two of the three elements in its nature are by definition wanton, even uncontrollable."[48] Moreover, if we accept the fickle nature of human judgment implied by Clausewitz in his discussion of real versus abstract war, then reason is relative and suspect as a predictable and stable element as well. Rationality, he would agree, is bounded rather than absolute. We are left with mathematical probability as the only apparent certainty, free to be manipulated to justify action and promise success with airs of objectivity, yet ironically without "firm basis in military calculations." That each element and that each balance between them is unique to each combatant and is fluid compounds the uncertainty intrinsic to the system as a whole.

Probability and Chance

Reason and passion, despite their myriad forms and complexities, are concepts easy to grasp. The notions of probability and chance are less precise and therefore deserve further exploration. Clausewitz unfortunately was not entirely clear on the distinction himself. Nonetheless, it is possible to draw a few sharp lines between them.

In broad terms, probability refers to informed calculations one can make about war. These informed calculations bifurcate into absolute (mathematical) probabilities that focus on physical strengths, and estimates that seek to account for moral factors.[49] Mathematical probability refers to the calculations one can make based on the physical strength of the armies, whether they were attacking or defending, and the terrain. Those calculations can help a commander or political leader make informed decisions about the physical capabilities and limitations of the force at his disposal. Mathematical probabilities help identify the risks associated with particular strategies or courses of action.

Given his belief that such calculations never find "firm basis in military calculations," Clausewitz argues that estimates of other factors must be added to give the calculations a basis in reality.[50] "From the enemy's character, from his institutions, the state of his affairs and his general situation, each side, using the *laws of probability*, forms an estimate of its opponent's likely course and acts accordingly."[51] Strategic intelligence is therefore crucial to Clausewitz in terms of forming an estimate of the situation and making reasonable judgments about the nature of the war. "Moral factors" and subjective assessments must inform the calculations.

Below the political level, however, the discussion of probability increasingly lacks precision. Clausewitz is clear that absolute probability is misleading, but the manner in which moral factors weigh in the balance is elusive, albeit crucial. His chapter on "Relative Strength" illustrates the problem.

> But in strategy, absolute strength is usually a given quantity which a general cannot change. Yet it does not follow that war is impossible for an army whose strength is markedly inferior. War is not always the result of a voluntary policy decision – least of all in instances where there is a great disproportion of forces. So one must admit any kind of relative strength: it would be a peculiar theory of war if it broke off just where the need for it was greatest.
>
> No matter how desirable adequate numbers may be for the purposes of theory, it is not possible to reject even the least adequate as useless. No absolute limits can be set.[52]

Moral factors, the resultant of the cognitive, psychological, and physical capacities of the force, are the truest measure of strength. By their very nature, however, they defy precise measurement. A theory of war, an estimate of relative strength, must account for them, but their measurement will, by its very nature, remain imprecise. Experience and intuition, rather than statistical calculations, are crucial.[53] "Circumstances vary so enormously in war, and are so indefinable, that a vast array of factors has to be appreciated – mostly in light of probabilities alone. The man responsible for evaluating the whole must bring to his task the quality of intuition that perceives the truth at every point."[54] The elusive nature of moral factors highlights the commander's quandary: he must evaluate the indefinable to arrive at real probability. The task cannot be reduced to absolute mathematical calculations alone, despite the comfort it might bring to the lesser mind. Proper estimate requires the military genius.

To further complicate matters, however, is the problem of chance. Clausewitz is elusive here again, often resorting to metaphors such as gambles and games of cards to

illustrate the concept. Chance seems to refer to events that simply cannot be foreseen.[55] At times chance is liberating. It is an opportunity for the commander to "revel in a wealth of possibilities."[56] It is a challenge to the commander's creativity to turn the unforeseen to his advantage. At other times, chance is an "intruder ... [that] interferes with the whole course of events." Because of the influence of chance, the commander engages in a relentless struggle with the unforeseen and unexpected.[57] To compound the problems of calculating real military strength chance intervenes to make "everything more uncertain."[58]

The concepts of probability and chance, so central to Clausewitz's theory of war, exacerbate the uncertain nature of war. Unlike his contemporaries, such as Jomini, Clausewitz saw in uncertainty a wealth of possibilities. The level of genius would determine the degree to which it liberated creativity or arrested the mind of the commander.

Moral Factors: The Uncertain Nature of the Military Force

Clausewitz discusses the nature of a military force in three broad dimensions: psychological, physical, and cognitive – all of which exist in unique and fluid balance with one another.[59] The psychological state of the organization textures the intensity and durability of physical strength and suggests the realm of the possible in the cognitive domain. The physical domain further informs the realm of the possible in the cognitive domain and affects the psychological state of the force. The cognitive domain must understand, guide, direct, and cultivate the physical and psychological strength of the

organization. The moral force can be implied as the concatenation of the psychological, physical, cognitive dimensions.

Clausewitz's brief chapter on moral factors, however, is decidedly unsatisfying from a theoretical point of view. Clausewitz argues that moral factors "constitute the spirit that permeates war as a whole."[60] He then discusses them as consisting of "physical and psychological factors," but then uses the sword metaphor to explain that the "physical seem little more than the wooden hilt, while the moral factors are the precious metal, the real weapon, the finely honed blade."[61] Thus, on the one hand the moral factors were made up of the physical and psychological factors, but on the other the physical is distinct from the moral, and the latter therefore is synonymous with the psychological. Clearly missing from the discussion is the talent of the commander, the cognitive factor that affects the physical and psychological. Clausewitz's chapter on Military Genius illustrates the criticality he gave the cognitive domain, but he curiously omitted it from the discussion of moral factors. He did, however, address the issue in his chapter on Relative Strength.[62] What is clear from the discussion and from the text as a whole, however, is that the intangible "moral factors" define the power of the military force.

As with the combatant state, imbalance in the military system – in the moral factors – would create disorder and defeat. A demoralized organization, regardless of physical strength and quality of decision makers, would be unable to function effectively. Complete lack of physical strength, regardless of psychological and cognitive health, likewise makes an organization ineffective. Lack of talent and poor decisions on the part of the commander can lead a physically strong and psychologically healthy organization to defeat. Holistic strength and balance, and an understanding of the nature of that

strength and balance, therefore, are critical. Knowing the enemy and ourselves means to know the moral factors.

Imperfect understanding and judgment, the inability to measure psychological forces, and the unpredictable manners in which each domain interacts with the other in the unique and fluid balance creates uncertainty. Although Clausewitz claimed that "the only situation a commander can know fully is his own: his opponent's he can know only from unreliable intelligence," his concept of the nature of combatants as expressed by moral factors suggests that even full knowledge of his own situation is elusive.[63]

Friction

Friction: A General Concept

Friction in war exacerbates uncertainty. Friction, Clausewitz famously asserts, "is the only concept that more or less corresponds to the factors that distinguish real war from war on paper." Friction is pervasive; it makes the simplest things difficult. "Countless minor incidents … combine to lower the general level of performance, so that one always falls short of the intended goal."[64] While the fact that friction will exist in all military operations is certain, how friction manifests itself in each "unique episode" remains uncertain. Each individual, he asserts, maintains potential for friction, particularly as the danger, exertion, and suffering of war intensifies. "This tremendous friction … is everywhere in contact with chance, and brings about effects that cannot be measured, just because they are largely due to chance."[65]

Clausewitz's study of war led him to postulate that danger, physical exertion, intelligence, and friction form the atmosphere of war. This atmosphere is a medium that impedes activity. From this observation he formed a "single concept of general friction" to coalesce the inhibiting forces in war under a single rubric. One scholar of Clausewitz has developed the idea further into the following useful taxonomy:

1. danger
2. physical exertion
3. uncertainties and imperfections in the information on which action in war is based.
4. friction in the narrow sense of the resistance within one's own forces
5. chance events that cannot readily be foreseen
6. physical and political limits to the use of military force
7. unpredictability stemming from interaction with the enemy
8. disconnects between ends and means in war.[66]

Friction creates uncertainty. Each of the above frictions affects the physical, psychological, and cognitive domains of combatants in unique ways. The effect of friction in a general sense, according to Clausewitz, is that it accounts for the difference between real war and war on paper. The manifestations of friction in war likewise differ in nature and degree in each unique situation. The outcome of friction, therefore, is uncertainty.

Friction and Human Perception

One further aspect of friction not addressed in the above taxonomy, yet central to Clausewitz's concept of friction and uncertainty, is the role of human perception and judgment. Clausewitz, as we discussed already, addressed the issue briefly in discussing modifications in practice in Book One, Chapter One, and how it contributes to uncertainty and the broad, conceptual level. Clausewitz returned to the problem in Book

Three in his chapter on "The Suspension of Action in War." Of interest to the study of uncertainty are the first two of the three determinants that lead to suspension of action: the fear and indecision native to the human mind, and imperfection of human perception and judgment.[67] The first determinant seems to be peculiar to the nature of each commander. Clausewitz argues that a commander with an "enterprising martial spirit" can overcome the natural tendency toward indecision and inaction. The second determinant, perception and judgment, appears more intractable. In an apparent contradiction with his optimistic statement that a commander potentially can know fully his own situation, Clausewitz remarks, "We hardly know accurately our own situation at any particular moment, while the enemy's, which is concealed from us, must be deduced from very little evidence."[68]

The realities of general friction begin to coalesce as contributors of uncertainty. Knowledge of our own situation is a problem larger than knowing the physical location of our own forces. The unique and situational effects of friction call into question all of the assumptions we make about the strength of the moral factors of our force. Evaluating the moral factors of the enemy is naturally even more problematic.

As Clausewitz observes in his chapter on Intelligence, "The difficulty of accurate recognition constitutes one of the most serious sources of friction in war, by making things appear entirely different from what one had expected."[69] The problem centers on perception, interpretation, and judgment. Clausewitz was far more sophisticated in his appreciation of human nature, the bounds of rationality, and the complexity of war than those who merely see his skepticism about intelligence perceive.

> One is lucky if [the reports'] contradictions cancel each other out, and leave a kind of balance to be critically assessed. It is much worse for the novice if chance

> does not help him in that way, and on the contrary one report tallies with another, confirms it, magnifies it, lends it color, till he has to make a quick decision – which is soon to be mistaken, just as the reports turn out to be lies, exaggerations, errors, and so on. In short, most intelligence is false, and the effect of fear is to multiply lies and inaccuracies. As a rule most men would rather believe bad news than good, and rather tend to exaggerate the bad news. The dangers that are reported may soon, like waves, subside; but like waves they keep recurring, without apparent reason. [70]

The problem is not that information is necessarily false. It is that the interpretation of that information by real people whose perspectives are shaped in the atmosphere of war lends meaning to it and forms impressions. Two reports that detail accurate information can have contradictory meanings. Other reports, meanwhile, can elicit the same meaning but be subtly or completely out of step with each other and with reality. Reports that are inaccurate can, conversely, give impressions that correspond nicely to the reality of the situation. Such impressions shape the actions of people in war. If we lived in the abstract state of objective rationality, the accuracy of reports and their meanings would pose no ambiguity. They would create no friction. The real world is far different.

> A general in time of war is constantly bombarded by reports both true and false; by errors arising from fear or negligence or hastiness; by disobedience born of right or wrong interpretations, of ill will; of a proper or mistaken sense of duty; of laziness; or of exhaustion; and by accident that nobody could have foreseen. In short, he is exposed to countless impressions, most of them disturbing, few of them encouraging... If a man were to yield to these pressures, he would never complete an operation.[71]

Each individual sees the world through lenses colored by the nature of the beholder in the atmosphere of war. The idea that different people can look at the same picture and interpret that picture in different and even opposite ways was not lost on Clausewitz. Like the myth of the cave in Plato's *Republic*, people see the shadows of reality, form impressions based on those shadows, and take action accordingly. For Plato it was the

philosopher who could see things as they really were. For Clausewitz it was the military genius.

The manner in which each combatant from private to general perceives events and their meanings forms impressions that affect the moral force of the individuals and the organization as a whole. These perceptions and judgments create friction in war. The consequences of such perceptions and the judgments and actions that result are the reasons why Clausewitz is so cautious about our ability to know accurately our own situation, much less that of the enemy. Information is but a small planet inside the universe of uncertainty.

Interaction

Uncertainties due to the nature of the combatants and the frictions intrinsic to them, within the uncertain framework of the war as a whole, are further exacerbated by the interactive nature of war. Clausewitz recognized the complexity of interaction: "... the conduct of war branches out in almost all directions and has no definite limits; while any system, any model, has the finite nature of a synthesis. An irreconcilable conflict exists between this type of theory [ones that focus on principles or rules] and actual practice."[72] The interactive nature of war, and the complexity of those interactions, makes war unpredictable.[73] Attempts to solve the problems of war with fixed rules are worthless.

> They aim at fixed values; but in war everything is uncertain, and calculations have to be made with variable quantities. They direct the inquiry exclusively toward physical quantities, whereas all military action is intertwined with psychological

> forces and effects. They consider only unilateral action, whereas war consists of a continuous interaction of opposites.... Military activity is never directed against material force alone; it is always aimed simultaneously at the moral forces which give it life, and the two cannot be separated.[74]

The complexity of war increases with the number of interactions among the animate forces in war. Complexity that manifests itself in ways unique to each situation is not reducible to fixed calculations. Interaction generates frictions and adaptations that form the distinctive shape and trajectory of each war.

Levels of Interaction

Interaction occurs at four levels: self, organization, enemy, and external environment, each of which by itself and in combination with others can generate unpredictable outcomes. Clausewitz discussed interaction with self and with our own organization primarily in terms of rationality and friction as discussed above. He also spent some time exploring interaction with the enemy and the external environment.

Interaction with the Enemy

War is by definition interactive and that fact generates additional unpredictability as the human rationalities and frictions of combatants clash violently.

> The essential difference is that war is not an exercise of the will directed at inanimate matter, as is the case with the mechanical arts, or at matter which is animate but passive and yielding, as is the case with the human mind and emotions in the fine arts. In war, the will is directed at an animate object that *reacts*.[75]

War, moreover, does not consist merely of a single interaction with the enemy. It is characterized by dynamic interactions that continuously alter its shape and contours. The unique nature of war, exacerbated by the unique interactions, creates trajectories that make outcomes unpredictable.

> The second attribute of military action is that it must expect positive reactions, and the process of interaction that results. Here we are not concerned with the problem of calculating such reactions – that is really part of the already mentioned problem of calculating psychological forces – but rather with the fact that the very nature of interaction is bound to make it unpredictable.[76]

War, therefore, is fundamentally different than a game of chess. Rather than a simple game of move-counter move, war exhibits constant interactions between the combatants. These interactions shape the impressions and judgment of the soldiers and commanders, affect the frictions that are natural to war, and generate outcomes that defy predictability, linear logic, and mathematical calculation. We will explore the issue of nonlinearity further in Chapter Seven.

Interactions with the External Environment

Interactions in war are not limited to self, organization, and enemy. The external environment also affects the war and the combatants in it. That external environment can be characterized as the "atmosphere of war" or its "climate" discussed above. It pertains to the physical environment – the terrain, the weather, and the time of day. It also consists of the influences of political leaders, higher headquarters, coalitions, and other third parties. Clausewitz does not develop, in detail, the totality of the interactions between a combatant and the external environment in his discussions of the nature of

war.[77] He does, however, discuss at length the concept of civil-military relations. The interaction that takes place between the political leaders and the commander can affect profoundly the nature and outcome of the war.

In Book 8, Chapter 6, of *On War*, Clausewitz develops his argument that war is an instrument of policy, and that the unity between policy and strategy "lies in the concept that war is only a branch of political activity; that it is in no sense autonomous." War cannot be separated by policy without turning into something "pointless and devoid of sense." Purely military opinions regarding strategy and plans, he asserts, would be unacceptable and damaging because they would be separated from the "guiding intelligence" of policy. Nor is it acceptable, he claims, to "summon soldiers ... and ask them for *purely military advice*," implying that soldiers must possess not only an understanding of political aims in which to contextualize their strategy and plans, but in some respects should participate in the crafting of the policy itself. Mutual understanding of policy, therefore, is paramount in achieving a unity between policy and strategy and thus a unity between the political and military. The interaction between political and military leaders shapes the initial aims of the war.

Interaction occurs between them during the development of strategies and courses of action, and continues throughout the course of the war. Policy, asserts Clausewitz, must be influential in the planning of the war, the campaign, and "often even of the battle." Political authorities, therefore, have the right and duty to intervene in the management of the war in honest pursuit of policy, provided, of course, that they understand the instrument they want to use. Only when they ask for military operations

to produce effects that are "foreign to their nature do political decisions influence operations for the worse."[78]

Policy governs strategy. The political and military authorities must possess a mutual understanding of the political objectives and the strategy to attain them. Political authorities, therefore, have the right to alter plans in pursuit of the political aim. In short, interaction between political and military authorities should be constant. The result of the interactions will shape the contours of the war.

Interaction and Complexity

Because interaction occurs in all dimensions simultaneously, the complexity of war increases. The diversity of the human intellect in attempting to cope with the unpredictability adds further uncertainty because there are myriad possible decisions and courses of actions that could result. Clausewitz invented the concept of "military genius" as the only reliable coping mechanism for war's complexity and uncertainty.

Genius "rises above all rules," he argues, because the creative commander recognizes each situation as unique and applies his own particular insight in determining the best way to proceed. Knowledge is absorbed into the intellect of the commander, becoming a part of his creativity. Since genius is a variable rather than a fixed quality, unique to each individual, the number of approaches to war and decisions in war is infinite. "What genius does is the best rule, and theory can do no better than show how and why this should be the case."[79]

The four major dimensions of interaction create a multitude of inputs that get interpreted. These impressions result in decisions and actions that create further

interactions and result in outputs. The possible permutations of the outputs are related to the number and complexity of the interactions. As Michael Handel noted, "Clausewitz's discussion of the infinite complexity and unpredictability of war on all levels is perhaps his most original and important contribution to the study of war. War is permeated by uncertainty, friction, and chance; it involves constant change on the part of the adversaries, who act and react independently, without ever having complete information on one another."[80] The uncertainty is exacerbated by the fact that interaction takes place in each of the four dimensions simultaneously, and that the interactions are interdependent rather than just independent. The magnitude of the complexity and uncertainty prompted Clausewitz to conclude, "In war more than anywhere else things do not turn out as we expect."[81]

Conclusions and Limitations

The more Clausewitz studied war, and the closer he came to understanding the nature of it, the more inexorably he was drawn to recognize and explore its intrinsic uncertainty. The concept is woven throughout the tapestry of *On War* with threads both subtle and obvious. At the broad level, the fact that real war differs from war in the abstract makes war inherently uncertain. The uncertainty manifests itself more precisely in the unique nature of combatants and the unique nature of the situation. Friction and interaction shape the unique realities of war, affecting and altering in turn the combatants and the situation. We see from Clausewitz the opportunities for creativity presented by

uncertainty as well as the crises it creates as people attempt to cope with its shadowy, complicated, and unforgiving nature.

Clausewitz's concept of uncertainty, however, is unfinished. Within the rough outlines of the concept there exist problematic and mixed metaphors. If war is a game of cards, then the number of combinations possible is fixed. If the deck is never shuffled, the probabilities decrease with each interaction. If the deck is reshuffled each time, the number of combinations remains the same for each game. His concept of interaction, however, suggests the outcomes expand with interaction rather than contract or remain fixed. If war is a duel, then one side must lose while the other must win – war is a zero-sum or fixed-sum game. However, if the political judgment that determines the political object is unique and textured by the nature of the state, its decision makers, and the situation, and if each combatant perceives reality differently, then war can have variable outcomes. That both sides can win and both sides can lose, that other combatants can enter the fray, whether in direct combat or by other means, had not yet entered the text in a substantive manner. Perhaps the metaphor of war as a gamble is illustrative of its unpredictability, but the random nature of gambling leaves no room for shaping by the military genius. If war were only about luck, then genius would not be required or even necessary. Genius cannot alter the outcome of a die, the flip of a card, or the location of the ball on the roulette wheel. Randomness and genius co-exist in war, but not necessarily in games of chance.

Subtle contradictions also enter the text. Clausewitz's concept of moral factors at one point is different from the physical, at another point is intertwined with it, and at yet another the physical is imbedded in the moral. Analysis of the trinity and triangle, and

his powerful idea that the theory of the nature of a combatant at war is like an object suspended between three magnets, does suggest that the object is the essence of the matter. Its shape and balance are determined by the strength of each magnet and the relationship between them. If moral factors are the essence of the matter, and if his trinitarian analysis is applicable at each level of organization, from the individual to the state, then the notion of physical, psychological, and cognitive domains being the magnets of a combatant force make logical sense. Clausewitz, however, never took the trinitarian concept to its logical progression from state through army to individual.

Clausewitz is open to the concept of bounded rationality. In fact his discussions of military genius, the concept of impressions and interpretations of information, the uniqueness of judgment, and the multiplicity of approaches, decisions, solutions, and outcomes, require it. He never explicitly squares the circle, however, between the idea that most intelligence is false and the "lack of objective knowledge" that makes information and intelligence perhaps not false, but not entirely true, either.[82] The concepts are present, but not fleshed out.

His idea that in war everything is uncertain is instructive and important but not very helpful. He was able to arrive at a general concept of friction and to suggest a taxonomy to express it, but he did not do the same for uncertainty. Even in his taxonomy of friction he conflates the ideas of uncertainty and chance in some areas and distinguishes them in others. Uncertainty is a contributor to friction, but he did not likewise express friction's role in creating uncertainty. Perhaps he would have arrived at a general concept of uncertainty had he continued to massage his ideas. All we know is that war is uncertain, but we can only arrive at why by reading between the lines.

Perhaps the concept was so obvious that it never dawned on Clausewitz to break it down further. The unfortunate consequences range from impressions that intelligence lacks utility in war to ideas that more precise information will "lift the fog of war."

Clausewitz's insights into the nature of war, however, provide a rich field in which to plant and harvest ideas and concepts. His insight into humanity and the nature of combatants provides myriad trajectories for exploration, particularly in the realm of uncertainty. The concepts of probability and chance, bounded rationality, discontinuities between decision and action, nonlinearity, and complexity open avenues in which to enrich the concept of uncertainty. His foray into the realm of military genius, which we will explore in Chapter Nine, provides insights on how leaders cope with uncertainty. Applying similar ideas to organizations and warfighting concepts will further the state of the art.

Noticeably absent from the text are ideas on how to create uncertainty in the enemy and exploit it. Nevertheless, understanding the nature of uncertainty opens pathways for analysis there as well. That *On War* expands rather than contracts thinking, that it challenges the bounds of creativity rather than restricts ideas to rules and aphorisms, is perhaps its richest quality. Its very uncertainty provides the atmosphere in which the creative spirit is free to roam.

Chapter Three

Defining a General Concept of Uncertainty

Military theorists are not alone in the failure to articulate a coherent concept of uncertainty. While studies in political, behavioral, and social sciences have examined uncertainty, there exists no common definition, no taxonomy, and no agreed conceptualization of uncertainty. In fact, most studies have focused on the manner in which people make decisions when the outcome of their choice is not certain.[1] Such studies have uncovered and explored important ideas such as bounded rationality and the importance of heuristics and biases in forming impressions and making decisions. They have also advanced the state of the art in terms of decision-making strategies, predictive analysis, and outcome management. Some analyses have pointed to the importance of modeling rational decision-making through the use of mathematical probabilities, while others have suggested the criticality of intuition in decision-making under stress.[2] That no single method, model, or paradigm has primacy suggests that uncertainty is more pervasive and complex than a single theory or model can handle. This chapter will explore a general concept of uncertainty by offering a definition and taxonomy.

Defining and Describing Uncertainty

The Webster's 3rd International Dictionary defines uncertainty as the "quality or state of being uncertain ... something doubtful or unknown." Uncertainty stresses a lack of certitude ranging from a small falling short of definite knowledge to an almost complete lack of it or even any conviction, especially about an outcome or result.

Heisenberg's uncertainty principle states that the momentum and position of a particle cannot be precisely determined at the same time. Uncertainty exists at the same time as a state of being and as an outcome. As one study suggests, "there is uncertainty about the significance of signs or stimuli and about the possible consequences of actions."[3]

As a state of being, uncertainty can exist at various levels of consciousness due to incomplete information, incomplete knowledge, and incomplete understanding. Uncertainty can be conscious. We might know that we are uncertain about the weather outside, about a company's financial performance, about the creation of the universe, the existence of God, or the location of something.

It can be unconscious in that our knowledge and understanding of something is incomplete but we do not realize it and therefore do not seek to know or understand it. Before Newton we knew things fell to the ground but did not know about gravity. For over a thousand years people accepted the Ptolemaic conception of the universe with the earth at its center. The concept of zero was unknown to ancient Greece and Rome. How automobile engines actually work remains a mystery to the majority of car owners that use the machines every day.

Uncertainty can also be sub-conscious. We are uncertain about our emotions. The profession of psychiatry is based on the premise that we have difficulty understanding our feelings and what goes on in our own minds. We do not know whether we can trust a particular person or not. We assume things to be true that are not true. We assume honesty in someone who in fact steals from us; we assume that a person who smiles is happy or who frowns is sad.

Uncertainty also exists about outcomes. We can have conscious uncertainty about the future. We might not know what the weather will be like tomorrow, whether the financial markets will go up or down, whether a company will still be in business in five years, whether our favorite team will win the championship, or whether there is life after death. We can have unconscious uncertainty about the future as well. The attack at Pearl Harbor on December 7, 1941 and the suicide attacks on September 11, 2001 were not necessarily considered impossible, only unrealistic. For that reason they were, in actuality, unforeseen. Our uncertainty can be subconscious. We assume someone with a great attitude today will have the same disposition tomorrow. We believe that certain sectors of the financial market will continue to behave in the near future as they had in the recent past. We assume that a large company that is in business today will still be in business six months from now.

If we apply Heisenberg's uncertainty principle, then we might conclude that existence has its own momentum. We can measure the state of being at a fixed point in time, but we cannot at the same time know its momentum. We can perhaps measure the momentum, but then we cannot determine the state of being. The ancient Greek philosopher Heraclitus argued that one could never touch the same river twice. Reality alters continuously. As economist Frank Knight observes, "It is a world of change in which we live, and a world of uncertainty. We live only by knowing *something* about the future; while the problems of life, or of conduct at least, arise from the fact that we know so little."[4]

Uncertainty, therefore, means *the inability to determine objective reality in the past, present, or future, precisely.* We live in a state of partial knowledge. As a result, a

state of absolute certainty is *a priori* impossible. The best we can do is to tie together fragments of partial knowledge to achieve some level of understanding the past, present, and future in order to make sense of this world. Errors, however, abound.

> The universal form of conscious behavior is thus action designed to change a future situation inferred from a present one. It involves perception and, in addition, a *twofold* inference. We must infer what the future situation would have been without our interference, and what change will be wrought in it by our action. Fortunately or unfortunately, none of these processes is infallible, or indeed ever accurate and complete. We do not perceive the present as it is and in its totality, nor do we infer the future from the present with any degree of dependability, nor yet do we accurately know the consequences of our own actions. In addition, there is a fourth source of error to be taken into account, for we do not execute the actions in the precise form in which they are imagined and willed.[5]

Nevertheless, to cope with our universe, we classify things. We assume that under the same circumstances, things will behave in the same way. We know that such certainty is not realistic, that nothing maintains an "unvarying identity" and that it is impossible to replicate precisely and repeatedly the multitude of conditions and circumstances that resulted in a specific behavior or outcome. "[T]o live intelligently in our world -- that is, to adapt our conduct to future facts -- we must use the principle that things similar in some respects will behave similarly in certain other respects even when they are very different in still other respects."[6] Once we assume similarity, we can begin to assess the likelihood that, given the existence of certain (albeit artificial) finite conditions and circumstances in the present, a particular outcome will occur. Such calculations open the door to probability.

Probability and Chance: Mathematical and True Uncertainty

Classification, despite its shaky foundations, enables us to establish the concept of probability. We can also, therefore, distinguish probability from chance. Probability and chance inform the two dominant rubrics of uncertainty: mathematical uncertainty and true uncertainty.[7] Probability deals in part with mathematical uncertainty. If an instance or decision is subject to precise quantification, then it is possible to generate strict mathematical probabilities about the outcome. This is called objective probability. Probability can also take on a more amorphous quality in the form of an estimate that relies on judgment and is subject to bias and error. This is called subjective probability or true uncertainty.

An estimate is used when there is no valid basis for classifying instances. For instance, when the nature of the participants or the nature of the situation is unique, we must form an estimate. The quality of the estimate is a function of education, experience, and judgment. Nonetheless, it is an estimate, the validity of which cannot be given a precise mathematical quantity.[8]

The existence of chance complicates the problem, even for mathematical uncertainty. Late nineteenth century mathematician Henri Poincaré argued that chance comes in three forms: a statistically random phenomenon; the amplification of a microcause; or a function of analytical blindness.[9] The existence of chance, whether in mathematics, economics, or war, can alter radically what seemed previously to be certain probabilities.[10]

Mathematical uncertainty can be classified into *a priori* probability and statistical probability. The first classification deals with homogenous instances in which the

probability for each event is identical, such as the roll of a die.[11] A statistical probability is more complex because it rests on empirical classification of like instances. These sorts of probabilities are used routinely by military planners when developing and comparing courses of action for a battle or campaign.[12] The model is necessarily one of attrition; "intangibles" are not a part of the calculations because of the obvious problems associated with attaching mathematical values to them. Thus, a newly formed platoon of Marines has the same unit value as one that has trained together for the past three years. Although the measure is not reflective of reality, it nevertheless generates probabilities of success.

Coping with mathematical uncertainty is a matter of risk. Commanders, for instance, can select a course of action that carries the least probability of a negative outcome. Conversely, they can select one that offers the greatest probability of success. There are also middle strategies in which there exist choices that offer different probabilities of gains but the same probability of loss, and vice versa.

Commanders can also use subjective probabilities to cope with risk. They can justify risks by making assumptions about intangibles. Thus, a highly trained, well-led, cohesive unit attacking a poorly trained, demoralized enemy at a 4:1 ratio can be a reasonable "risk." At this point, however, decision-makers are entering the realm of true uncertainty, because in war the concatenation of variables is unique in time and space.

True uncertainty is therefore infinitely more problematical. While we appreciate some conscious uncertainties such as lack of complete information, the most pervasive and problematical true uncertainties exist in the subconscious and unconscious realms. They exist in assumptions we rarely think to question. They exist in complexities that we

simply do not or cannot understand. They exist in our inability to get into the mind of the enemy, and in the concept of free will. True uncertainty is manifested in chance, revealed in unique agglomeration of frictions, and problematized by the dynamics of the human psyche and interactive adaptations in time and space. Each situation in war is unique because the physical, cognitive, and psychological characteristics of each combatant are both unique and fluid due to the interactive nature of war. As a result, it is impossible to classify precisely each instance in war to arrive at an objective probability of outcome.[13]

Taxonomy of Uncertainties

Uncertainty is commonly understood as a matter of information.[14] If this is the case, then the argument that information superiority, or "dominant battlespace knowledge," can "lift the fog of war" is plausible.[15] Uncertainty, however, is not reducible to information. To be sure, **simple uncertainties**, those unknown but attainable pieces of existing information, can be reduced radically by information technology. But simple uncertainties merely scratch the surface of the issue.

Another type of commonly appreciated uncertainty, and one not necessarily reducible to existing information, concerns **the future**. According to one influential study, such uncertainties can be grouped into four categories. The first is called a Clear Enough Future in which the forecast is precise enough for strategic development. Although the inexactitude of human endeavor will make absolute certainty impossible, the future points inexorably toward a single strategic direction. Next are Alternate Futures in which a few discrete outcomes are plausible. Third is a Range of Futures in

which the actual outcome can lie anywhere along a broad continuum bounded by that range, but no discrete outcomes are obvious. True Ambiguity is the last category. In this case there is no basis upon which to forecast the future.[16]

Vision is another part of uncertainty about the future that must be added to the construct. Vision is an attempt to create an image of the future and then to develop plans, policies, and programs to achieve it. Imbedded is a degree of doubt, conscious or otherwise, over whether the vision is the correct or best one. The enemy attempts to achieve vision as well, and these competing visions and implementation schemes can undermine existing plans, create unforeseen opportunities and crises, and can even make an existing vision absolutely untenable.

Between uncertainties that result from gaps in existing information and those over scenarios of the future, however, are several other types of uncertainty that are impossible to predict precisely but that have a determining effect.

Intrinsic Uncertainties result from bounded rationality – those factors that can create a gulf between perception and reality. Cognitive biases, emotions, assumptions, experiences, education, and heuristics are all factors that shape the meaning people elicit from information. Two individuals can look at the same data and derive completely opposite conclusions from it, and consequently can make fundamentally different decisions. Particularly in complex, unique, and ambiguous environments, the decisions and actions that result due to bounded rationality can be highly unpredictable.

Frictional Uncertainties deal with the inability to determine precisely how friction will manifest itself. Equipment failures are part of the friction of war. More prevalent, however, are frictions that result from poor communication between people,

fear, danger, exhaustion, disobedience, initiative, will, inertia, and other human factors. These frictions can affect individuals and organizations in ways that defy prediction and expectation.

Dynamic Uncertainties are the most problematical because they result from interaction. The concepts of Chaos, adaptive complexity, and nonlinearity, as we will explore later in the study, illustrate the inherent unpredictability present in war when forces interact. An input that generates a certain response from one system will likely generate a much different response from another. Destroying the communications network of one combatant, for instance, might lead to such disruption that the combatant will not continue the war. The same input to another combatant might merely increase the intensity of the resistance. The outcomes that result from complex interaction, therefore, defy prediction.[17] Adding the challenges of intrinsic and frictional uncertainties, as well as those of competing vision and forecasts of the future, exacerbates the problem.

Coping with Uncertainty

Under the old paradigm coping with uncertainty has traditionally meant collecting more information, refining analysis, and developing strategic postures. In so doing, the decision-maker must have an appreciation for what is knowable and accessible and what is not. He or she must also understand the amount of resources required to gain additional information and determine whether the effort is worthwhile. The decision-maker then develops strategies to shape or adapt to developments and to determine the

right "portfolio of actions" for the response.[18] Uncertainty was something to be overcome (information) or something to "bind" (anticipating the future).

The existence of frictional, intrinsic, and dynamic uncertainties suggests that the old paradigm is incomplete. First, coping with uncertainty requires the deliberate creation of resilience to manage the effects of inputs and interaction on the system. Chaos, adaptive complexity, and nonlinearity suggest that instability and fragility in the system can lead to unpredictable, disproportionate, and dysfunctional outcomes. Coping in advance with uncertainty requires creating the conditions necessary for resilience in the system. Second, it demands the need for versatility and flexibility to respond to crises and opportunities in a manner that derives maximum advantage from the situation. Last, it argues for the development of an approach to war that focuses on the creation and exploitation of uncertainty in the enemy.

Using a working definition of uncertainty and taxonomy to identify significant classifications, it is now possible to study the manner in which uncertainty manifests itself in war. To structure the analysis, I will address three broad components of uncertainty: the human, nonlinear, and interactive. These three are interconnected and interdependent dimensions of war. Together they will help illustrate how uncertainty manifests itself in combat and conflict.

The analysis will begin with the human dimension of war. We will enter the fascinating realm of human perception and interpretation, explore how uncertainty manifests itself in the cognitive domain, and illustrate the impact of bounded rationality on decision-making. Next, we will move from the decision maker to the individual

combatant and organization and discuss the continuities and discontinuities between decisions and the actions that result from them in war.

The human factors also give war its nonlinear nature. The actions of combatants in war and the effects of those actions can often defy proportionality. Nearly impossible to predict, nonlinearity can generate outcomes radically different than could be reasonably foreseen. As combatants interact with themselves, their organizations, the enemy, and the external environment, the human and nonlinear components in turn and in combination add complexity that exacerbates uncertainty. The myriad interactions and adaptive complexity result in outcomes that, while logical in hindsight, can be unthinkable in foresight.

Finally, we will analyze specifically how we can cope with our own uncertainty and exploit that of the enemy. The discussion will focus on leaders, organizations, and warfighting concepts, using insights from the study to suggest ideas on the development of resilience as a means to cope with uncertainty. It will also explore the powerful potentialities of exacerbating and exploiting the uncertainties of the enemy.

Chapter Four

The Human Dimension of War: Observation and Orientation

A number of contemporary observers have argued that information technology will make the battlefield transparent. Commanders will have an "omniscient view" because they will be able to "see" with "unprecedented fidelity, comprehension, and timeliness."[1] Such an omniscient view generated by sensors fused together in information loops, they argue, will present a precise picture of the battlefield in real-time. The resulting clarity will give the US military "Dominant Battlespace Knowledge" relative to any opponent.[2] One scholar representative of the information technology thesis has argued that as the ability to see the battlefield continues to improve, "even perfect situational awareness may *understate* what US forces can see."[3]

The premise is that data fused together and filtered for relevance constitutes information. When that information is packaged onto a screen and converted into "situational awareness" for the commander it becomes knowledge that gives the commander understanding of the battlefield.[4] What these arguments presuppose is that movement through the cognitive hierarchy – from data to information to knowledge to understanding to wisdom – is made automatic and seamless in the transparent battlefield. The process in the real world, unfortunately, lacks such continuity.

Detailed studies in the behavioral sciences have uncovered that our understanding of the world is translucent rather than transparent. How we perceive and interpret the world around us results from how we process external stimuli and the meanings we attach to them. We make assessments of significance and predictions of the future through the

lenses we have crafted over a lifetime of experience and education. As a result, two people can look at exactly the same picture and come to completely opposite conclusions about it. The mere existence of different political parties, religions, and philosophies illustrates the divergence powerfully. Because we perceive reality through our own translucent lenses, our understanding of the past and present and the significance we attach to it is bounded and shaped in our minds. That texture informs our predictions of the future and the decisions we make to generate the outcomes we desire. The challenge is exacerbated in war by the fact that we must understand an enemy as well -- an enemy that actively seeks our destruction. The chapter will describe the uncertainties involved in how we process, understand, and attach meaning to information.

The OODA Loop

The Boyd Cycle, or OODA loop, is a useful but problematic paradigm for understanding decision-action cycles in combat. A former US fighter pilot, John Boyd sought to understand the reasons why aerial combat outcomes in the Korean War so heavily favored the US pilots despite the fact that enemy aircraft were superior in many respects. Boyd discovered that the slower but more agile F-86 bested its faster but more cumbersome counterpart, the MiG-15, because the former aircraft had a bubble canopy that enabled US pilots to see the battlespace more effectively than the enemy. Because visualization of the engagement was better, the US pilot could take advantage of the superior agility of the F-86 to maneuver more effectively and precisely than his enemy could. The ability of the US pilot to "Observe" the situation, "Orient" on a critical aspect of it, "Decide" on a course of action, and "Act" on that decision was markedly faster than

that of the enemy pilot. At some point, the US pilot would get inside the OODA loop of the enemy pilot. When this occurred, the decisions of the enemy pilot became more and more inappropriate. He was reacting to an old situation while a new one was presenting itself. Being a step behind the US pilot, the enemy would take actions that merely made him more vulnerable. Finally, the enemy pilot would make a critical error that the US pilot could use to win the encounter. The time competitive decision-action cycle can be seen as more of a spiral than a loop: the side that executes the OODA faster will force the slower opponent into a decision-action spiral that increasingly puts the latter in jeopardy.[5]

Boyd's theory in many ways revolutionized how military thinkers conceptualized combat. The theory of "maneuver warfare" in particular is founded on the OODA loop. Coming to fruition in the mid to late 1980s as the US military grappled intellectually with the problem of fighting a numerically superior Warsaw Pact in Central and Western Europe, maneuver warfare postulated an alternative to attrition. The maneuver warfare theorists argued that more rapid execution of the Boyd cycle would lead to the psychological collapse of the enemy.[6] Reinforcing the concept was the proposition that combat outcomes are decided in the mind of the enemy commander rather than by the amount of blood on the battlefield.[7] As the enemy commander made decisions and took actions that were increasingly inappropriate and, indeed, ones that made his own problems worse rather than better, he would suffer psychologically from the sense of futility and would give up. The concept offers considerable power in explaining combat outcomes of quick, decisive, victories.

Blitzkrieg in the battle of France, 1940, became the example *par excellence* of the Boyd cycle in action. Believing that the Germans would invade France through the Low

Countries as they did in the First World War, the French and British weighted their forces opposite Belgium and Holland. To their south was the dense and complex terrain of the Ardennes forest, believed to be so difficult to traffic by armored formations that the Germans would not use that avenue for their main attack. South of the Ardennes stood the formidable Maginot Line.

The Germans initially planned to attack through the Low Countries, but changed their concept to focus their armored formations instead in the Ardennes in order to achieve surprise. Since the bulk of the British and French armored formations were concentrated on the approach from the Low Countries, the German thrust through the Ardennes would also serve to offset the general Allied numerical and armored superiority by creating local German superiority at the point of penetration near Sedan, France.

The German plan worked. Despite the fact that many French formations remained intact, the swift thrust through the Ardennes to the Channel coast led to panic in the Allied armies and political leadership. The Germans simply operated with a tempo greater than that of the French. The French could not blunt the German penetrations nor restore subsequent defensive lines as their doctrine of "Methodical Battle" mandated. The Allied forces and their political leadership collapsed psychologically before they were rendered powerless through attrition. Maneuver warfare, in short, presented an alternative to attrition. Rather than victory through attrition, commanders could win by generating paralysis, shock, or dislocation, in the minds of the opponent.

Contemporary observers have taken the argument a step further: that dominant battlespace awareness plus precision stand off weapons can generate the same psychological solution to war without placing US forces in harm's way on the ground.[8]

In a curious merge of an attrition warfare method (precision strike) inside a maneuver warfare outcome (shock, lockout, paralysis, dislocation) some enthusiasts believe they have found an antiseptic, certain, and bloodless solution to war. It is a remarkable inversion of the late 1980s mentality. Then, psychological collapse was a method of victory distinct from that of attrition. For IT-RMA enthusiasts, whether they like to admit it or not, attrition is the foundation of collapse.

The Boyd thesis, although a powerful and useful paradigm, must be supplemented by an understanding of uncertainty. Too often, emerging operational theories and concepts, particularly ones that advocate a technological solution to war, fail to account for the collective human dimension. The risk of such conceptions is that they can paint a false picture that may lead to unrealistic perceptions and expectations about war. The gulf between perception and reality – part of the uncertainty of war – provides necessary insight into the cognitive and psychological domains. A better understanding of those domains can help us develop more realistic warfighting concepts. A study of uncertainty leads to different analytical questions than those typically posed and results ultimately in more sophisticated and realistic approaches to the complexity of war.

Bounded Rationality: Challenges in Observation and Orientation

Key to understanding the power and frailties of human understanding is the concept of bounded rationality. As far back as ancient Greece, thinkers have argued that we do not see "objective reality."[9] What we see instead are images of reality that are shaped by our perspectives. Rather than being objectively and perfectly rational beings, we are imperfect beings that perceive images of reality. Perceptions are shaped by our

cognitive experience. Our images of reality, in other words, are bounded by our individual natures. They are not absolute and perfect. Two different people can look at the same picture or the same information and arrive at diametrically opposed conclusions. A person who views the attainment of money, rank, or status as the ultimate good might look at co-workers as enablers, stepping-stones, and obstacles. Another person who views relationships as the ultimate good might view the same co-workers as colleagues, friends, and peers. For one, cutthroat competition for promotion is just the nature of life, for the other such competition would be unthinkable. Human rationality is dependent upon frame of reference.

Absolute rationality also implies an ability to comprehend perfectly objective good and truth. Being perfectly rational would mean that all of our decisions and actions would aim directly at a single, universal, ontological good. Each of us, however, has different and often changing definitions and interpretations of the good that textures our decisions and actions. The individual who sees the attainment of money, rank, or status as the ultimate good might not hesitate to ruin a relationship to attain that goal. The other individual who sees healthy relationships as the ultimate good, will forgo the physical trappings of wealth for the relationship. Given the same set of circumstances, they would make completely different decisions. The decision of each would be rational, but the rationality of each has a fundamentally different subjective basis. With that brief exploration into the concept of bounded rationality, we can begin to look more closely at how human beings process and interpret information.

Translucent Lenses and Cognitive Maps

Knowledge and understanding are human, cognitive functions. The manner in which we view and process information is determined by the totality of our cognitive experience: our assumptions, biases, emotions, experiences, aspirations, abilities, and education. We view the world through translucent lenses. Life experiences and education also form "cognitive maps" in our minds that enable us to attach significance to stimuli. The translucent lenses from which we view the world and the cognitive maps from which we derive meaning are forged in the crucibles of life and learning. They enable us to process stimuli, impart meaning, and make assessments and judgments.[10] Because we are human, the roads heading from information toward knowledge and understanding are varied and tortuous; some are dead ends, others meander aimlessly, some move toward our goal, others head off in the wrong direction. The roads intersect along the way, the choices we make at each intersection are shaped by our cognitive experiences. The journey itself is an experience, altering our lenses, texturing our maps. To complicate matters, we make multiple journeys at once. The destinations we wish to reach are sometimes complementary, sometimes subtly divergent, other times in direct conflict, and often uncertain. Information, however precise, is but part of the landscape. How we view the terrain, in detail as well as in broad focus, and the meaning and significance we attach to it, shapes our perspective and understanding.

Understanding how people process and interpret information and the discontinuities that result is crucial in the study of war. The most powerful examples of disparities in how people process information come from examinations of surprise attacks. One scholar has examined in detail eleven major surprise attacks since the

outbreak of the Second World War. His analysis illustrates powerfully the discontinuities between information and understanding, or in Boyd's terminology, between observation and orientation.

> Analysis of surprise attacks suggests that the intelligence community seldom fails to anticipate them owing to a lack of relevant information.... A study on warning intelligence sponsored by a US Congressional Subcommittee on Evaluation examined the warning process during such political crises as Pearl Harbor, Korea, The Cuban Missile Crisis, the 1968 Soviet invasion of Czechoslovakia, and the Yom Kippur War, and found that in no case had lack of data been a major factor in the failure to anticipate the crisis.[11]

What the studies of surprise attacks reveal, and what many studies in the behavioral sciences have confirmed, is that how we process information and the meaning we attach to it is a complicated and conflicted process. Information does not determine its own relevance; that is up to the human being.

Heuristics and Biases in Observation and Orientation

Modern theories of perception and memory suggest that people interpret information, reach conclusions and make assessments about what they have seen or what they remember based on reconstructing their knowledge from fragments of information. During this reconstruction process, a variety of cognitive, social, and motivational factors texture the meaning we derive from information.[12] One theory argues that individuals simplify reality by filtering information through systems of beliefs and judgmental heuristics, or "cognitive maps" of the environment.[13] These maps provide a coherent way of organizing and making sense out of the confusing, ambiguous, and conflicting array of signals acquired by the senses.[14] These knowledge structures enable us to

categorize and classify information and determine a set of expectations and assessments. These structures can serve us well, but they can also induce significant error.[15]

An important series of studies in the behavioral sciences argues that people generally interpret information using three judgmental heuristics: availability, representativeness, and adjustment and anchoring.[16] These heuristics texture the meaning we attach to stimuli.

The availability heuristic means the ease in which relevant instances and occurrences can be brought to mind to explain and make assessments about the present situation.[17] The heuristic is useful because general patterns of behavior and causality often exist. Frequent events are recalled easily. The examples are available to us as explanations and predictors. The role of personal experience is the foundation for availability. The heuristic, therefore, can also be influenced by emotions, biases, recency, and vividness.

Experience can be of great explanatory power, but it can be imprisoning at the same time. For instance, the terrorist attacks of September 11 have had interesting effects on everyday life in America. Despite the fact that the probability of another such attack is arguably remote, and that an infinitesimally small number of Arabs or Muslims are terrorists, the vividness and recency of the terrorist attacks have led to a number of policy debates and decisions ranging from changes to airline security to arguments over the virtues and vices of ethnic profiling. The new security measures have consumed a huge amount of resources to prevent recurrence of the September 11 attacks. They have also generated problematic actions, such as the detailed searching of elderly women, to avoid

the appearance of ethnic profiling. "We pay excessive attention to low-probability events accompanied by high drama and overlook events that happen in routine fashion."[18]

Conversely, despite the wealth of information and prognostications prior to September 11 that a terrorist attack on American soil was probable, the nature in which the attacks took place was a complete surprise. The attacks were difficult to imagine based on the lack of availability. As Roberta Wohlstetter explains in her landmark study on Pearl Harbor, "There is a tendency in our planning to confuse the unfamiliar with the improbable. The contingency we have not considered seriously looks strange; what looks strange is thought improbable; what is improbable need not be considered seriously."[19] Furthermore, experience had taught that the best way to deal with airplane highjackers was to do what they asked without fighting back. Such methods had been successful in the past and most highjackings had ended peacefully. Applied to the September 11 highjackings, however, the availability heuristic was inappropriate.

A second heuristic is representativeness.[20] This rule enables us to estimate the likelihood of one state of affairs given knowledge of another state of affairs and assessing the similarity between the two. Like availability, representativeness is a very useful heuristic to simplify the complexity of life. It assumes that given similar conditions, the outcome of one event will resemble that of another. For instance, small company stocks historically outperform large company stocks in the beginning of an economic recovery. The representative heuristic would suggest that when investors recognize the onset of a recovery they should weight their portfolios toward small company stocks.

Representativeness, however, can lead to an illusion of validity based on fragmentary or insufficiently causal data. People can attach too much importance to random or

unrepresentative evidence or events, and thus make predictions about outcomes they believe will be most representative of the input. Learning from history is problematic if we draw conclusions based on a cursory analysis -- if we focus more on what happened than appreciating the complexity of why it happened.[21] The recent campaign in Afghanistan is a classic case in point on a variety of different levels.

As the United States began preparations for military action in Afghanistan, some critics pointed to the Soviet debacle there as representative of the likely outcome of an American military campaign. Other critics argued that, based on recent experiences in Vietnam and the lackluster support for military action in the Balkans, Americans were reflexively casualty averse. Still others saw the specter of Vietnam in which a high-tech US force battled a low-tech indigenous force and lost. Predictions of quagmires abounded in the halls of punditry.[22]

In each case, however, the use of the representative heuristic led to significant interpretive flaws. First, the Soviet invasion of Afghanistan was done on behalf of a communist Afghan government that represented only a tiny minority of the people. The armed revolution against the regime led directly to armed conflict against the Soviet forces. Because the majority of Afghans opposed the government, they also opposed the Soviets. Despite Soviet tactical successes, the campaign gained no strategic dividends because the government being supported was not legitimate in the eyes of the people.[23] A similar argument can be made for the US and the government of South Vietnam.

Nevertheless, the situation in Afghanistan in October 2001 was fundamentally different. The US was opposing an unpopular, repressive, and illegitimate government in the eyes of the Afghan people, rather than supporting one. The US was not seen as an

invading power, but rather as an ally of indigenous anti-Taliban forces. The political environment, therefore, between the seemingly representative situations were diametrically opposed. Because the context was fundamentally different, the US has been able to wage, to this point, a successful campaign where others had failed. Likewise, arguments about the reflexive American aversion to casualties rang hollow. Americans seem willing to accept casualties when the stakes are high enough. Like the British during the interwar period, Americans today use the meaning of the war to determine levels of acceptable cost; casualty acceptance or aversion is determined by the situation, not by abstraction.[24]

Adjustment and anchoring is the third heuristic.[25] It describes how people integrate new information into existing paradigms (anchoring) and make adjustments. With this heuristic, people begin with a starting point, or initial assessment, and then adjust that assessment as new information becomes available. Returning to the financial market analogy, analysts might begin by assessing that the market is in a recession based on earnings and unemployment data. As time progresses, however, change occurs. New information shows companies meeting or exceeding earning estimates; consumer confidence begins to rise as unemployment declines. Analysts will then at some point begin to adjust their assessment from recession to recovery.

Shortcomings abound with this heuristic as well. In the world of finance, one influential study argues, the market overreacts to short-term news and then under-reacts while awaiting new short-term news of a different character.[26] In other words, a small amount of information can create an impression and an interpretation. New information of a contradictory nature, even if in more abundance than the information used to make

the initial impression, is often not enough to adjust the anchor in an appropriate manner. Before the Second World War, for instance, the British planned to defend Singapore with a small garrison, and then dispatch a fleet to prevent an enemy attack if danger arose in the area. Once the war in Europe began, however, it was clear to the British that they could not afford to send a part of the fleet to protect Singapore. At the same time, Japan occupied Indochina and gained control of its airfields. Despite these rather drastic changes in conditions, the British persisted in their belief that Singapore could not be conquered and consequently adhered to their old but completely inappropriate strategy.[27]

Perception, Memory, and Meaning

Our cognitive maps, the translucent lenses we use to view the landscape, and the heuristics we employ to understand and navigate it, illustrate in part the concept of bounded rationality. Another part is the persistence of initial beliefs and assessments despite information that might contradict or problematize them. To be sure, there might exist those who believe they can know nothing and therefore attempt to avoid forming any opinions or drawing any conclusions about anything. They would be flexible in the extreme. There are others at the opposite end convinced they know everything and feel no need to listen, ask questions, or learn.[28] Most of us, however, fall somewhere in the middle.

Because our cognitive maps and our understanding of them seem very reasonable, we can become trapped in a system of beliefs that can distort reality, generate erroneous expectations, and draw unrealistic predictions about the relationship between seemingly rational expectations and expected outcomes.[29] In short, people exhibit greater certainty

about assessments than are generally warranted because they believe they have a much better picture of the present and future than they actually do.[30] Moreover, as the study of anchoring shows, people tend to form impressions and opinions based on small amounts of initial information. Once that information is filtered and leads to a conclusion, the initial belief persists despite evidence that suggests the initial conclusion was incorrect. These studies further suggest what at first glance might seem counterintuitive: that oftentimes little to no correlation exists between the collection of additional information and improved analytical ability.[31]

Part of the reason for the problem is that people can and will filter information. We tend to disregard information that contradicts our opinions and assessments and give greater weight to information that confirms them. In some cases, contradictory information is simply ignored, misperceived, unnoticed, or treated as "noise."[32] In other cases people will force events into alignment with opinions and mental constructs, particularly when dealing with ambiguous information.[33] As Ephriam Kam observes in his study on surprise attacks, "Incoming information about the enemy's behavior can be interpreted in several different ways, and it is precisely this ambiguity that analysts seize on to prove their hypotheses and reinforce their belief[s] ... they read and interpret information in a manner that suits their hypotheses and beliefs, ignoring other possibilities."[34]

Yet another recurring problem is that of wishful thinking. Psychologists have noted a general tendency to exaggerate the gratifying features of the environment and to overestimate the likely occurrence of desirable events. People tend to predict that events that they want to happen actually will happen. Indicators and "signal" get processed into

these paradigms to confirm initial impressions and expectations. Such signals get regarded with more evidentiary power than ambiguous or conflicting data. Often, the latter are regarded merely as noise.[35]

Psychologists have noticed four distinct trends in the manner in which people form general concepts.

1. "When people already have a theory, before encountering any genuinely probative evidence, exposure to such evidence ... will tend to result in more belief in the correctness of the original theory than normative dictates allow."

2. "When people approach a set of evidence without a theory and then form as theory based on initial evidence, the theory will be resistant to subsequent evidence."

3. "When people formulate a theory based on some putatively probative evidence and later discover that the evidence is false, the theory often survives such total discrediting."

4. People require more evidence to change their minds about an existing conception than they did to arrive at that decision in the first place.[36]

In war in particular, when the stakes are so high and the outcomes so uncertain, people tend to maintain their existing paradigm and force reality into the straitjacket of preconceived notions.[37] Stress, the frictions of danger, exertion, and responsibility, impose an even greater desire for simplicity as tolerance for ambiguity reduces markedly.[38] In high stress environments, information can have a paradoxical quality. Several experiments have shown that judgments become more inconsistent as the amount of information increases. More information, rather than increasing accuracy, increases confidence in initial assessments instead.[39] When faced with complexity people tend to use existing models, filtering, intellectual short-cuts, and a variety of other reductionist formulas to make it intelligible.[40]

The manner in which information is presented and framed can texture the meaning, validity, and significance people attach to information. The advent of the computer has had some interesting results in this regard. One solution proposed to the problem of data overload is to fuse information systems together through automation. The system is supposed to present a coherent and "perfect" picture of the situation to commanders.[41] A picture, however, even a computer-generated fusion of information, is merely an image of battlefield reality. It can display physical relationships, but it cannot account for critical intangible factors and ambiguity. The meaning of the picture remains in the eye of the beholder.

Computer representations of reality can, however, create a dangerous illusion of certainty. Information passed by one person to another, experiments show, is treated with a degree of skepticism that is textured by our knowledge of the individual passing the information. Information arriving on a computer screen, however, is perceived uncritically to have greater credibility. The illusion of certainty can create a serious gulf between perception based solely on the appearance of physical representations and the reality of the situation based on the physical, cognitive, and psychological domains of combat.[42]

Perceptions of the Enemy

The gulf between perception and reality, merely in understanding our own perspective on the present and future, is exacerbated by our attempts to understand the enemy and his perspective. The dangers of oversimplifying from our own perspective are obvious, harmful, and real enough to illustrate the uncertainties of information in the real

world. Attempting to understand the enemy further increases the complexity. The environment of war contains a thinking, intelligent, uncooperative, and unpredictable enemy who often sees the world fundamentally differently.[43]

Trying to get inside the enemy's head in order to gauge his intentions and predict his behavior is a challenging, often elusive endeavor that adds to the uncertainty of war. We often begin by making an assumption that the enemy will behave "rationally." In his landmark study of conflict, Thomas Schelling argues that the assumption of the enemy as a rational actor can achieve only very limited analytical results. The rational paradigm assumes that the enemy is operating on an explicit and internally consistent value system that enables him to calculate precisely and uncritically courses of action that seek maximum advantage.[44] Such assumptions, however, may result in serious distortions. The enemy's rationality is bounded as well. What we believe is to his maximum advantage may be very different from his own concept of maximum advantage. The enemy, in the realm of bounded rationality, may evaluate his own capabilities and options by different criteria. He may also evaluate our capabilities and options differently than we do. He may reach conclusions, and act in ways that make perfect sense according to his cognitive map, that are unthinkable according to ours. As Alexander George asserts, "An incorrect image of the opponent can distort the appraisal of even good factual information on what he might do."[45] The intractability of surprise in war only begins to unpack the complexity of the challenge of predictive analysis.[46]

The enemy's conceptual framework alone, however, does not by itself determine his behavior. The enemy is also acting on information about himself and us that is filtered through his own lenses. From that picture he perceives opportunities and crises.

He assesses options available and options closed to achieve his purpose in battle or war. He calculates capacity and willingness for risk. As a result, we can understand the enemy's conceptual framework but still fail to estimate and predict his behavior because we are not aware of what information the enemy has acted upon. At the same time, what we might regard as too risky for the enemy might appear much different from his perspective.[47] The meaning of information is in the eye of the beholder, the consequences of which are decidedly complicated and uncertain.

Consequently, people can fall into the traps of script-writing and mirror imaging when developing strategy and conducting predictive analysis.[48] Script-writing is the logical fallacy that results when people do not account for the fact that war is interactive. They assume the enemy will react predictably and programmatically within the confines of the plan we have written. The enemy, however, learns and adapts, and the script we have written to generate a set of outcomes often results in ones that have the opposite of their intended effect. Paradoxes and the laws of unintended consequences begin to rum rampant. Mirror imaging, on the other hand, results when we assume the enemy sees the world exactly the way we see it, and we develop plans and make assumptions about the war based on those mirrored preconceptions. Naturally, the perception about the war for the mirror-imager and the reality of the war as it unfolds can diverge radically. Script-writers, in essence, deny that the enemy has a vote; mirror-imagers believe the enemy will vote precisely as they would.

These problems are magnified when coupled with the assumption that events will unfold in a straight line that leads inexorably toward victory. The neat and tidy plans and assumptions begin to diverge from reality in subtle as well as radical ways. A participant

in recent Navy Transformation wargames issued a sobering summary about exuberant prognostications of quick decisive victories: "Previous RMA discussions have seemed to assume that precision and maneuver are the antithesis of attrition, that a single decisive blow will bring an enemy to terms. To the contrary, these games continually raised serious questions ... In the words of one player, 'What if the enemy doesn't know he has lost?'"[49] The enemy gets a vote in war. His perception of reality and basis of rationality can be fundamentally different from our own. Such divergences can confound strategists, analysts, and observers.

A study of the American experience in Vietnam raises an interesting case in point. One of the biggest problems for the Johnson administration was in knowing what to look for in terms of signals from Hanoi during the bargaining for a negotiated settlement to the war. The administration had little understanding of their counterparts in North Vietnam: "precisely because the Administration did not understand the subtleties of DRV decision-making, its handling of the various diplomatic contacts with Hanoi between 1965 and 1968 was marked by considerable clumsiness."[50] Uncritical and unrealistic assumptions about what motivated North Vietnam, about their decision-making, about the bases of their rationality, led in part to the fundamentally flawed strategic concept that we could win the war by manipulating the cost benefit equations through attrition.[51]

Perception and Reality

Uncertainty in observation and initial orientation, both in terms of knowing ourselves and knowing the enemy, can create a gulf between perception and reality that grows wider and more problematical as the situation unfolds. The 1933 German Army

Troop Leadership manual expresses the challenge aptly: "Situations in war are of unlimited variety. They change often and are rarely from the first discernable. Incalculable elements are often of great influence. The independent will of the enemy is pitted against ours. Friction and mistakes are frequent occurrences."[52] Even subtle differences between perception and reality at the outset can result in wide divergences as the situation develops and gains complexity and momentum. Often the chasm develops and the crisis becomes apparent simultaneously with the realization that what once seemed manageable is now completely out of control. "As time passes, unsolved problems within a given paradigm tend to accumulate and to lead to ever-increasing confusion and conflict."[53]

The challenges in adjustment from "anchors" in initial assessments highlighted above spiral in complexity as the competing wills and perceptions of the enemy interact with ours. These initial perceptions persist in the minds of people, often despite evidence that contradicts directly the premises of those impressions. People tend to concentrate on confirming initial beliefs and hypotheses rather than deliberately seeking disconfirming evidence that challenges them.[54] They tend to attribute greater reliability to evidence that confirms these initial constructs, and dismiss contrary evidence as "unreliable, erroneous, or unrepresentative."[55] People also tend to fit ambiguous and even conflicting information into pre-existing images and predictions.[56] If conflicting information cannot fit into the pre-existing conceptions, people will often develop coping mechanisms that enable them to maintain their initial constructs. One study has identified ten such techniques that people use to assimilate conflicting information without altering initial beliefs.

1. They fail to see that the information contradicts their beliefs so they ignore or dismiss it.

2. They reinterpret information to confirm their initial views.

3. They reject the validity of discrepant information or treat it as of little consequence.

4. They can evade the problem and pretend no conflict exists.

5. They discredit the source of the discrepant information.

6. They simply refuse to alter their views.

7. They seek new information to strengthen challenged beliefs – "bolstering."

8. They seek to discredit the discrepant information by treating it as a deception effort – "undermining."

9. They split information into different parts and adjust beliefs only concerning the part that is causing the attitudinal conflict – "differentiation."

10. They combine concepts into a superordinate concept at a higher level, consistent with other beliefs – "transcendence."[57]

Given these human proclivities in observation and orientation, we can also begin to see why deception can be very effective in war once we understand some of the conceptions upon which the enemy is operating. The most effective deceptions, naturally, are the ones that present a picture the enemy wants to see – they fit neatly into pre-existing constructs.[58] Part of the deception plan in Operation OVERLORD (D-Day invasion) in World War Two about a "second and larger invasion force" led by General Patton was effective in large part because it conformed with pre-existing German beliefs on several different levels. Another interesting insight is that combatants are quite good at deceiving themselves, even without any help from the enemy.

Uncertainties in Observation and Orientation

To return to our uncertainty framework, even with reductions in simple uncertainty possible with information technology, observation and orientation are filled with intrinsic, potential, predictive, and dynamic uncertainties that exist *a priori*, and that are both created and exacerbated by our own efforts and those of the enemy. Even a perfect physical image of the battlefield must be placed on top of our own cognitive maps and be viewed through our own translucent lenses as we process, interpret, and draw conclusions and make assessments about information, meaning, and outcomes. In war, the complexities increase because our assessments must also account for what we believe to be inside the enemy's head – the textures of his cognitive map and the shape and shading of his lenses -- an enemy that very likely sees the world in ways fundamentally different than the way we do.

At a different level, conceptualizing the nature of war in the future is subject to the same challenges of assessment and prediction. Militaries are criticized often for "refighting the last war" when anticipating what war will be like in the future. Much of the criticism is warranted, but much of the problem of being a prisoner of experience is intrinsic. Winners do get complacent, losers become more innovative as they try to solve the problems of the last war. The impact of technology and conceptual change is often difficult to anticipate, as are the results when they interact with the enemy in war. The challenges are exacerbated by the fact that it is impossible to think outside the box about the future if one's entire intellectual experience has remained inside the box.

Understanding the notions of cognitive maps and lenses and how they texture uncertainty in observation and orientation are critical in avoiding cognitive traps. They should also inform the study of history and combat. Oftentimes the most severe "blunders" in war and the most spectacular surprises begin with uncertainties in observation and orientation rather than incompetence or stupidity. As Rebecca Wohlstetter argues, "The signals that seem to stand out and scream of the impending catastrophe are the ones learned about only after the event, when they appear stripped of other possible meanings."[59] Based on the premises generated in observation and orientation, commanders can make wholly rational, seemingly very appropriate decisions that prove to be ineffectual or utterly disastrous. Merely working backward from results in war in order to make assessments can lead to dangerously flawed conclusions about historical events. We must understand the maps and lenses of the combatants and work forward from there in order to make a meaningful analysis.

Uncertainties in observation and orientation are inherent in war because they are fundamental to human nature. Given the nature of those uncertainties, it is highly unlikely that taking the human out of the loop and leaving all analysis and assessment to computers will have any meaningful impact. In fact, computers might be even easier to deceive because, operating autonomously, they interpret information predictably. The deceiver would not have to understand problematic cognitive maps or lenses of human counterparts. Despite the human shortcomings of observation and orientation, taking the human out of the loop would not solve the challenges of war.[60] Uncertainty offers the prospect of success; the illusion of certainty, properly exploited by the enemy, can lead to disaster.

We have only begun to scratch the surface of uncertainty in the analysis of the observation and orientation components of the decision-action cycles. Decision contains uncertainties as well. In the next chapter we will unpack the seemingly straightforward and uncomplicated concept of decision and examine the inherent unpredictability of decision-making from both the friendly and enemy perspectives.

Chapter Five

Uncertainties in Decision-Making

The previous chapter explored uncertainties in the observation and orientation processes of the decision-action cycle. Given such uncertainties as input into the process, it should not be surprising that the decisions people make can and often do defy predictability. This chapter will illustrate uncertainties in decision-making by examining how people make decisions. We will begin by looking at game theory and how rational decision-making in the abstract is supposed to occur, and then we will examine the shortcomings of game theory as predictive of real life. Next we will discuss how decisions are made in organizations and how factors such as risk and decision-making methodologies can affect substantially the output of the process.

Game Theory

Imagine you are in a room with 9 other people. Your task prior to leaving the room is to pick a number between 0 and 100 that is two-thirds of the average of all the picks of the participants. Game theory suggests that there exists a rational strategy and solution to the game. You begin with the fact that the highest number anyone could pick would be 67, since that is two-thirds of 100. However, you must assume that the nine other players have figured this out as well, so your next possible pick would be two-thirds of 67, or 45. Again your competitors have figured this out as well, so you must divide by .67 again to arrive at 29. As you continue to work through the interactions, you finally come to the conclusion that the only logical answer is 0. Welcome to game theory.

Game theory is designed to indicate what rational decision-makers should do to maximize their gains in conflict situations.[1] It is crafted specifically to account for interaction. The concept is to model the best decisions a player can make given the probable decisions of the other player. Game theory was created by John von Neumann to analyze and predict strategic behavior. The result of his efforts and those of his successors is an entire branch of mathematics, impressive in its complexity, but not in its ability to tell us what people will do.[2] Nevertheless, game theory does offer some interesting insights into the world of decision-making in conflict. I will use three simple games as a matter of illustration.[3]

The first is a two-player game between Joe and Mike in which each of them can choose between three courses of action. The outcomes have been reduced to the numerical ones Table 5.1 below.

		Joe		
		A	B	C
Mike	I	-5, +5	0, 0	-2, +2
	II	+3, -3	**+2, -2**	+3, -3
	III	+2, -2	0, 0	+5, -5

Table 5.1

The cell in the center is the solution: Mike chooses strategy II and Joe chooses strategy B. In this case, each player knows the possible outcomes and plays the game correctly. The

logical solution for Joe is to pick B. By selecting A or C he runs the risk of increasing his losses from –2 to –3 or -5. Mike's optimal solution is II. By choosing this strategy he guarantees himself a gain of 2 regardless what Joe chooses. This strategy is called a "minimax" strategy. By selecting B Joe is minimizing the maximum amount he can lose. Mike employs the same minimax strategy by choosing II. In this type of game, one player does not know the choice of the other. Each assumes that the other will seek to maximize gains while minimizing losses. The logical result is a risk-averse solution. Being risk averse in uncertainty, therefore, is the rational choice in the minimax paradigm. A different assumption of risk, as we will discuss later, could result in a much different choice for each player.

Not all games, however, have solutions in which the best outcome is the most "rational" one. The next game is called the Prisoner's Dilemma. Two men, Tim and Bob, are arrested for fraud. If convicted, each will receive punishment of 2-5 years, depending on what the prosecution recommends. The District Attorney, however, does not have enough evidence to convict either one. He needs one to sell-out the other.

The DA puts them in separate cells. He tells Tim that if he confesses and Bob does not, the DA will drop the fraud charge for Tim and let him plead guilty to a lesser charge that carries 3 months in prison. If Bob also confesses, the DA cannot drop the charge but he will ask the judge for leniency – 2 years each.

If Tim does not confess but Bob does, the DA will ask for the maximum five-year sentence for Tim. If neither confesses the DA cannot get a fraud conviction, but can convict them of lesser offenses and get a six-month sentence.

After explaining all of this to Tim, the DA goes to Bob's cell and gives the same speech. Table 5.2 shows the matrix of outcomes for each.

Tim begins to reason his way through the options. Tim decides that if Bob confesses and he does not, he will get 5 years; if he confesses too, he will get two years. If Bob is going to confess, he better confess too. If neither of them confesses, he goes to jail for 6 months. If Bob stays silent, however, and he confesses, Tim only gets three months. So, if Bob stays silent, he is better off confessing. In fact, regardless of what Bob does, he is better off confessing.

		Tim	
Bob		Confess	Silent
	Confess	2 yrs, 2yrs	3 mo, 5 yrs
	Silent	5 yrs, 3 mo	6 mo, 6 mo

Table 5.2

Both criminals come to the same conclusion and begin making their confessions.

The solution to this game is interesting for two reasons. First, both confess because they reason correctly that confessing is better than staying silent, regardless of what his partner in crime does. The strategy to confess dominates the strategy to remain silent. Since both players have optimal strategies, the game has a logical solution.

The second point, however, is that by acting rationally and by assuming the other person with whom they could not communicate would act similarly in a minimax

paradigm, they are both worse off. Had they both remained silent they would have gotten only six months. The point is that rational behavior of individuals in a group, in this case a group of only two, can lead to results in which they are all worse off.

The same sort of logic applies to soldiers who flee from the battlefield. Survival can be rational from a minimax point of view and fleeing can thus become the dominant strategy. If everyone flees, however, each individual will be worse off. Casualties in combat are far greater when fleeing in a rout than when fighting. Rational behavior from the survival perspective is very likely to lead to greater harm.

The outcome can be much different given an alternative basis of rationality. Ardant du Picq's aphorism that 4 soldiers who do not know each other will not dare attack a lion, but the same four soldiers if they know each other well and are confident in mutual aid will attack the lion resolutely, follows the logic of game theory.[4] The key is that the highest good for all four must be something other than individual survival. In this case, the greater good can be to support one's comrades or to kill the lion. Thomas Schelling frames the issue as follows: "People can often concert their intentions or expectations with others if each knows that the other is trying to do the same. [Such concert is not inevitable, but] ... the chances of their doing so are ever so much greater than the bare logic of abstract random probabilities would ever suggest."[5] Mutual trust and understanding are foundations for collective action in war. We will return to this issue in Chapters 6 and 9.

Not all games have solutions by rational deduction. The third game is Rock, Paper, Scissors. In this two-player game, each participant begins with a clenched fist. On the count of three the players put out their hands simultaneously in one of three

positions: a fist is a rock, two fingers out means scissors, and a flat hand signifies paper. The winner is determined as follows: paper covers rock, rock smashes scissors, scissors cut paper. The outcomes are represented in the following matrix.

	Rock	Paper	Scissors
Rock	0, 0	-1, +1	+1, -1
Paper	+1, -1	0, 0	-1, +1
Scissors	-1, +1	+1, -1	0, 0

Table 5.3

This game is interesting because there really is no strategy to solve it unless your opponent becomes predictable. The outcome of one round has absolutely nothing to do with how the next round will come out. Each situation is unique.

While no winning strategy is apparent, there is an obvious one to avoid. A predictable player, whether that player always chooses paper or chooses according to a set pattern will soon find himself losing consistently once his opponent discovers the pattern. The best option in this zero-sum game is to be unpredictable.

Thus far we have discussed two-person games only, although some games like the prisoner's dilemma can be transferred easily into many-person games. Nevertheless, there is an additional concept in game theory that warrants attention: the Nash Equilibrium. In this game you are a person involved in an iterative game for a long time.

You observe what other players do and try to alter your play accordingly to generate the best outcomes. You also assume that what you do will not affect what they do – perhaps because you cannot model such effects or because you believe your impact is really too small to matter.

As the iterations continue, you change your play until you become convinced that no further change will improve your outcomes. Equilibrium occurs when you reach an optimal strategy for you based on the strategies the other players are following. Such a solution is called the Nash equilibrium.

A couple of real-life examples illustrate the point. In the United States everyone drives on the right – this is a Nash equilibrium. The solution is stable – people would continue to drive on the right even if no police were present to enforce the rule. An individual choice to drive on the left would be prohibitively dangerous and costly.

In England people drive on the left. This is a Nash equilibrium as well, but it is a costly one because cars have to be manufactured specifically for drivers in England. If all drivers in England switched to the right, they might all be better off. The cars would be cheaper and foreign tourists from right-side driving countries might be less of a hazard behind the wheel. A driver or group of drivers who tried to implement the solution unilaterally, however, would be worse off.

Some Nash equilibriums can be stable against individual action but not against joint action. A guard with only one bullet in his gun facing a mob of prisoners is an example. A single individual is better off surrendering and staying alive rather than charging the guard and ending up dead. Two or more prisoners are better off charging the guard, with the odds of a favorable outcome increasing as the numbers grow.

Nash equilibrium solutions, however, are not always unique. If the actions of an individual do have an impact on the rest of the group, then the nature of the equilibrium will be fluid rather than static. The optimal solutions will continue to change due to the choices of others. Furthermore, not all situations are perfectly iterative like the automobile driving scenario. Situations in war are quite often very unique in character and the actions of one do have an effect on others. Two opposing combatant units might reach a sort of temporary stand-off until a soldier or small group of soldiers acts differently and alters the situation fundamentally. A temporary Nash equilibrium in war can therefore be unstable against individual and joint action, and that destabilizing action can be subtle or dramatic. Herd instinct might be stable for each individual in the herd, but the actions of the herd as a whole might change based on the actions of an individual.

Uses of Game Theory

The failure of game theory to predict behavior in the real world can be seen, ironically, as one of its most important contributions. It illustrates the criticality of bounded rationality in decision-making.[6] Despite its quest to reach a degree of certainty in outcome, game theory instead illuminates uncertainties in terms of how people make decisions. In our very first game we came to the conclusion that the rational solution was 0. This solution, however, is based on the premise that each player saw winning the game as most important. Let's replace some of our nine automatons with real people. One person has an important job interview at the end of class and does not have the time to work through the math. She writes a guess on a piece of paper so she can go. Another student thinks the game is silly and picks a number at random. A third person is a

Literature major with no mathematical inclination at all. He simply does not know where to begin. He eventually picks a number at random and moves on to studying Robert Frost. Each of these people, by virtue of individual rational choices, has taken the game's presumed rational solution and rendered it incorrect for that particular game. Psychological and environmental factors and differing definitions of the good bias choices and render them sub-optimal in the abstract, although they might be rational and optimal in the real world. Real people operate on a cognitive model rather than on one of abstract rationality.[7] Simply put, different people have different assumptions and perspectives from which they view the world and order priorities. People in the same situation are often playing the same game by different rules or are playing different games altogether. The basis of rationality is different for different people.

A second related issue is that choosing what is "rational" is clearly not always the optimal solution. Games such as the prisoner's dilemma and solutions such as the Nash equilibrium illustrate clearly that even if we can deduce the enemy's goals and intentions correctly and can even identify the most rational strategy to meet it, the possibility of predicting his behavior incorrectly is very real. Other forces at work – such as his deduction of our likely strategy, or pressures in the enemy's environment (internal or external) – might convince the enemy to do something completely different than what is rational in the abstract.

Game theory also suggests that we should open our minds to the concept that war is not necessarily a zero-sum or fixed sum game. It can be a variable sum game in which both sides can declare victory.[8] Such battle outcomes seemed routine in the Peloponnesian War in which both sides would fight and then set up trophies in different

places commemorating a victory. Examples exist in the modern world as well. The German victory over France in 1940 can be seen as a variable sum outcome. France clearly lost the brief war, but they retained a measure of autonomy through the creation of Vichy France. By making peace when they did, the French gained an outcome that might be considered unwarranted given the lopsided nature of the military outcome. Saddam Hussein in 1991, after his forces were crushed in the Gulf War, gained an outcome in which the oil dispute with Kuwait was solved to some degree of satisfaction, several of his Republican Guard Forces remained intact, and his development of weapons of mass destruction has continued unfettered by UN inspectors. In Kosovo, Slobodon Milosevic was able to create and sustain a refugee crisis of Albanian Kosovars despite the NATO air campaign. His regime collapsed in the long-run, but at the time he made peace with NATO he had accomplished in large measure the ethnic cleansing of Kosovo.

War can be a variable sum game because combatants can have multiple objectives in war. Myriad viable strategies can exist to accomplish them, rather than just the single "rational" one modeled by game theory. Instead of optimizing, for instance, combatants can satisfice – select the first option that works even if it is not the best one.[9] Similarly, since rationality is bounded and since war is time competitive, a combatant simply might not have the time to work through all of the available options and select the optimal one. Satisficing, therefore, is often the most efficient and "rational" approach.

Game theory also illuminates the difference between myopic and non-myopic rationality. Myopic rationality means looking only one step ahead and optimizing at each step. Non-myopic rationality suggests that behavior is rational if it optimizes final outcomes, even if it involves bad or sub-optimal intermediate results.[10] Spoiling attacks

and feints, for instance, are conducted generally to set the conditions for a successful future battle. They are structured for success only from the perspective of the final result rather than the immediate outcome.

Another observation is that the problem of "compounding expectations" is very real. A modest temptation to initiate a surprise attack, for instance, although maybe too small by itself to motivate an attack, could become increasingly attractive and seemingly crucial after successive cycles of "He thinks we think he thinks we think ... he will attack; so he thinks we will, so he will, so we must."[11] What seemed irrational when viewed in the abstract becomes entirely rational when coupled with certain assumptions about enemy behavior.

A final issue is the notion of risk. Game theory does a nice job identifying minimax strategies to two-person games, but cannot calculate the tolerance of the individual decision-maker for risk. In the game between Joe and Mike (above) the minimax solution is predicated on the assumption of risk-averse behavior. Suppose Mike was a risk-seeker. He could remain with strategy II, or he could go for the best outcome and select III. The worst he will do is come out with nothing. He can, however, gain 5.

Research into the psychology of risk shows that the issue is more complicated than the reflexive pursuit of minimax outcomes. Part of the choice about risk involves the stakes of the outcome. Someone fighting against the odds for self-preservation naturally has a far greater tolerance for risk than his adversary does. The decision often revolves around how the issue of gains and losses is framed for the decision-maker. When the choice involves losses, we are risk-seekers. People will take a risk to reduce losses over the certainty of a fixed loss. Conversely, people are generally risk averse

when the issue is framed in terms of gains. People will choose to lock in the certainty of a fixed gain over the potential of no gain. Even though the logic of strict probabilities might argue otherwise, generally the most compelling factor in decision-making under risk is loss aversion.[12]

An issue related to risk is that of failing to ignore sunk costs. Rationality based on the minimax paradigm argues that the cost of the war up to the present should have no bearing on subsequent decisions. The opportunity to minimax should rule. Bounded rationality takes over in the real world, and sacrifices already made can weigh heavily and even tie the hands of decision-makers who are responsible to their people and influenced by their own personal emotions. Theorist Edward Luttwak observes, "But if the costs of war are unexpectedly large, their very magnitude will be an incentive to persist during an intermediate stage: the greater the sacrifice, the greater the need to justify it by finally achieving the advertised gain."[13]

A potential, but problematic, solution to the uncertainties of human decision-making due to bounded rationality is to have computers make all choices.[14] Game theory shows that a critical source of uncertainty, an unsolvable uncertainty at that, lies in the intentions of others.[15] For perfectly rational computers, however, game theory can be quite predictive. Computers can process information more quickly, can run through the gamut of possibilities, and generate the optimal solution much faster than human beings. In the words of one proponent, "The logic leading to fully autonomous systems seems inescapable."[16]

As the rock, paper, scissors game shows, however, predictability in games can lead to trouble once your opponent can determine your strategy while keeping his

unpredictable. The two-person zero-sum game between Mike and Joe (Table 5.1) offers an interesting case in point about predictability and deception. Mike sends indicators that convince the computer that he is opting for strategy I. The most rational choice for the computer would be A. The deception works and Mike selects II. He now gains 3 while the computer loses 3. Game theory has also illustrated that the outcomes of seemingly rational choices are not always optimal. The fact that game theory cannot solve multi-person variable sum games should add further caution to uncritical acceptance of automated decision making in war. Once again, assumptions that computers are by nature more effective than humans in the games of real life are problematical at best.[17]

Essence of Decision

Thus far we have used Game theory to illustrate how factors such as bounded rationality, variable-sum outcomes, satisficing, non-myopic rationality, and risk create uncertainties in decision-making. All the while we have assumed a unitary rational actor model paradigm for the decision-maker even though we have textured the model a bit by introducing the presence of bounded rationality. The manner in which organizations make decisions rarely reflects the neatness of the unitary rational actor model or the logic and mathematical precision of game theory solutions. As Thomas Schelling argues, "some of the most momentous decisions of government are taken by a process that is not entirely predictable, not fully 'under control,' not altogether deliberate."[18] The remainder of this chapter will discuss some alternatives to the unitary rational actor model, specifically the cognitive and intuitive models, the organizational behavior model, and

the governmental politics model. As we will see, each of these models can result in a decision by an organization. Often times what model is operating will determine the nature of the output.

The landmark study, *Essence of Decision*, examines how decisions were made in the Cuban Missile Crisis. These decisions shaped the manner in which the crisis evolved and why it ended without a nuclear exchange between the two superpowers. The study is a fascinating and most important exploration of real-world decision-making. Authors Graham Allison and Philip Zelikow argue that there are three conceptual models that explain how governments make decisions. Model I is the Unitary Rational Actor Model. Model II is the Organizational Behavior Model, and Model III is the Government Politics Model.

We will begin with the Unitary Rational Actor Model (Model I). According to Allison and Zelikow, we commonly assume that governments are unitary rational actors, in that there is a single decision-maker or unified decision-making body that makes choices in the name of the state. The Model I paradigm assumes that "governmental behavior can be most satisfactorily understood by analogy with the purposive acts of individuals."[19] In other words, it treats a national government as if it were a centrally coordinated, purposive individual. The decision maker is equated with the government, and all decisions from the state are attributed as the product of a single, homogenous, rational body that calculates deliberately in the pursuit of its interests.

This simplification is useful in terms of trying to understand and predict the intentions and behavior of another state. To be sure, the national leader is there to make

critical decisions. That individual or body has the express purpose of maximizing the interests of the state and is supposed to do so in a logical, systematic, and rational way. Such neatness is the very foundation of assessment in intelligence and foreign affairs.

While the simplification can be helpful in ordering complexity, it obscures a number of salient factors that influence how decisions are made. A government, an army, or any large and complex organization is not a single calculating individual, but a vast array of individuals and bureaucracies with different functions, perspectives, and agendas all of which shape the manner in which issues that require decisions are raised and framed. Furthermore, even the lead decision-makers have competing and conflicting issues that shape perspectives and decisions. Bounded rationality removes decision-making in the real world away from unambiguous abstract rationality and places it squarely into the realms of cognitive bias and intuition. The unitary rational actor model, while useful in assessing possible outcomes in a simplistic paradigm, is inherently inadequate.

Alternatives within the rational actor paradigm are the cognitive and intuitive decision-making models. The cognitive model takes the concept of bounded rationality and applies it to decision-making. One scholar argues that "a growing volume of research reveals that people yield to inconsistencies, myopia, and other forms of distortion throughout the process of decision-making.... [T]hese flaws are even more apparent in areas where the consequences are more serious."[20] Particularly in situations involving high stress and ambiguity, people place more emphasis on subjective weights than on mathematical probabilities. Judgmental bias, in other words, is a pervasive feature in decision-making.[21] Just as our cognitive maps and translucent lenses shape

how we perceive the world around us, they also texture the decisions we make. Frictions due to danger, exertion, stress, competing priorities, and ambiguity exacerbate the challenges for the decision-maker. As fatigue grows, as the situation increases in complexity, and as time for contemplation vanishes, decision-makers rely increasingly on judgmental heuristics and biases.[22]

Moreover, no guarantee exists that the decision maker will even be proficient in the level at which that person must make decisions. Historian Roger Beaumont suggests, "In a military equivalent to Parkinson's Law, those habituated to focusing closely on a few details across a narrow range ascend the rungs of the military hierarchy, passing into an environment in which traits required to function effectively are the reverse of those that led them to success at lower levels, as they follow an analogical progression from mechanical skills through science to art."[23] Uncertainty increases in the progression from the tactical to operational to strategic realms, as well as within gradations of each realm itself. Success in handling the responsibilities at one level in no way guarantees continued success at subsequent levels. Similarly, the decision-maker might behave in a certain manner at one level only to behave in an opposite manner at higher levels. An aggressive, risk-taking commander at one level can become risk-averse and cautious at the next level as uncertainties and responsibilities increase and "safety-nets" for errors decrease. Cognitive decision-making, because it is unique to each individual, creates uncertainty from both friendly and enemy perspectives.

Related, is the theory of intuitive decision-making explored by Gary Klein in *Sources of Power*. Intuitive decision-making is based fundamentally on experience. Decision-makers that can function effectively in time-constrained, high stress

environments, according to Klein, build mental simulations based on their experiences, apply a prototype of them to the present situation, and then develop a reasonable reaction to cope with it. They do not waste their time using analytical methods because they do not need them or do not have the luxury of time to employ them.[24] While such methods can result in reasonable solutions and strategies, their effectiveness is limited by the fact that experience is the only meaningful foundation for the decision-making. Intuitive decision-makers can become prisoners of their own experience. Sole reliance on that method can result in perpetual mediocrity. Nevertheless, the use of intuition is prevalent and by its nature uncertain and unpredictable unless one has a personal understanding of the individual decision-maker. Intuitive decsion-makers "satisfice" out of habit and necessity. Perfection is the enemy of good enough. For intuitive decision makers good is indeed good enough.

The rational actor model is further problematized by the fact that decision-makers are not lone actors hermetically sealed from outside influences. They are members of organizations that contain people and bureaucracies who provide information, make recommendations, process actions, engage in constructive behavior and petty rivalries, and make the government or military function. The influences of organizational and key subordinate behavior shape decisions in powerful ways.

The Organizational Behavior Model (Model II) emphasizes the influence of large organizations that function according to regular patterns of behavior.[25] Acts and choices, according to this model, are outputs of bureaucracies and staffs operating under standard procedures to perform specific, routine functions.

During the Cuban Missile Crisis, a number of Soviets actions could not be explained by the rational actor paradigm and were therefore confusing to American analysts. For instance, Khruschev's initial decision to send some nuclear weapons to Cuba in order to gain strategic leverage turned into a vast deployment of IRBMs (Intermediate Range Ballistic Missiles), MRBMs (Medium Range Ballistic Missiles), and scores of tactical nuclear weapons for coastal defense that went far beyond what the Soviet Premier had in mind. The Americans had no idea the Soviets had placed such a massive arsenal in Cuba. Had the US carried out their planned invasion, a nuclear exchange might have been inevitable.

Furthermore, the Soviets failed to camouflage the missiles which led to their discovery in Cuba by US intelligence. One possible explanation is that this was an example of gross incompetence or negligence. What was expressly supposed to be secret was compromised by leaving the missiles in the open. An alternative explanation would suggest that the Soviets wanted the US to discover the missiles. Perhaps the Soviets were using them as a bargaining chip to gain concessions in Berlin or to get the US to remove its missiles in Turkey. Perhaps the Soviets were trying to provoke military actions. All sorts of explanations are possible using a Model I paradigm, but such analysis might mistake the real cause of the apparent anomaly and generate troubling and unnecessary consequences.

These seemingly bizarre or even sinister actions, however, are perfectly reasonable when viewed through a Model II lens. When the decision to send nuclear weapons to Cuba got processed through the Soviet bureaucracy, the logic of routine procedures and practices took over and the deployment assumed a life of its own. From a

military standpoint, merely sending a few nuclear weapons to Cuba that could do no real damage to the US or deter an attack on Cuba would be preposterous. What you really need, they apparently thought, is a robust and layered system that can strike targets all over the US. You also need a healthy supply of tactical nuclear weapons and missiles to protect the ballistic missile arsenal. Bureaucratic procedures generated an outcome that differed markedly from Khruschev's intention.

The situation is similar regarding the lack of camouflage. The Soviet Strategic Rocket Forces" standard operating procedure called for emphasis on readiness. Their routines had been designed for situations in which camouflage had never been required. Therefore, making the missiles operational received priority and every effort was made to accelerate the process. In so doing they made the missiles visible. The reasons behind inadequate camouflage were not rooted in incompetence or deliberate policy design but in organizational processes that no one thought to question at the time because they were so routine and accepted.[26] Because they are so imbedded in everyday life, bureaucratic processes can lead to significant unintended outputs and consequences when operating in unique situations.[27]

An example from the Second World War illustrates the issue further. Nobel Laureate Kenneth Arrow was a weather officer in the US Army Air Force during the Second World War. A part of the Bomber Command staff consisted of forecasters whose purpose was to predict the weather over Europe a month in advance and provide input to the long-range planners. Arrow and his team of statisticians, however, found that their forecasts were no more reliable than ones picked at random out of a hat. The forecasters agreed with him and asked their superior to relieve them of the duty. He replied, "The CG

is well aware that the forecasts are no good. However, he needs them for planning purposes."[28]

Bureaucratic routines and processes, standard operating procedures, and regulations are necessary for efficiency in organizations. They must be able to perform routine operations proficiently. The precise execution of routine enables an organization to perform with speed, fidelity, and competence. The procedures and policies they follow generally are designed to accommodate the most likely situations rather than all eventualities. While superb when performing tasks in predictable environments, bureaucracies can generate puzzling and even bizarre outputs in unique situations. The seductive power and efficiency of the routine can lead to assumptions that standard outputs have universal applicability. We do not even think to question whether the likely output will be consistent with our goals in the situation. Nor do we anticipate that the output of the process may not promote, but may even undermine, those goals. Particularly in rigid bureaucracies, the law of unintended consequences tends to manifest itself in unique situations. Once again, it is nearly impossible to think outside the box when your entire intellectual experience is inside the box.

Unthinking adhesion to rigid process, however, is by no means inevitable. Organizations, staffs, and bureaucracies are made up of individuals, some of whom are intellectually equipped to think through ambiguity and uniqueness. Sometimes their voices are heard and processes get adjusted. Sometimes they are drowned in the momentum of the machine as dissent is ignored in favor of routine and conformity.[29] Nevertheless, uncertainty exists in both the law of unintended consequences and in the role of the individual in adjusting bureaucratic output. What at first glance might seem

like an incompetent, irrational, but conscious decision on the part of the leader turns out instead to be the competent output of an organization that is subtly or radically divergent from what the specific situation and common sense would dictate. Beyond some threshold of no return the leader becomes powerless to alter the outcome of process. The unconscious and subconscious faith in the fidelity of process that had been so intellectually comforting, so necessary to the organization, and had served the leader so well in the past can prevent recognition of obvious disaster until it is too late.

The Government Politics Model (Model III) analysis also sheds some very interesting light on the manner in which decisions are framed and made. In this model, decisions are seen as a resultant of bargaining games among officials in the government.[30] A Model III analysis takes into account the positions and perspectives of officials who influence decision-makers. Depending on the situation, the relationship between officials, and the competence of those wanting to influence decisions, the resultant can be a surprising outcome. For instance, governments in times of conflict or crisis often contain those who are considered "hawks" and "doves." The group that has the most influence on the decision-maker will have the most -- but not always the only – impact on the resultant. Oftentimes, however, positions are not even that well defined or predictable.

During the Cuban Missile Crisis, members of the Kennedy administration often flip-flopped on their recommendations. Robert McNamara, for instance, was the leading dove during the first week of the crisis. By the second week he became so resigned to

military action that he began to see "new virtues and possibilities in trying a surprise attack against Cuba."[31]

An incident occurred that seemed to further the case made by the hawks. The Soviets fired a surface to air missile that killed the pilot of a U-2 spy plane. The Americans believed that Moscow had given the order to shoot down American planes. The Soviet perspective was much different. Khruschev had no idea that his forces were the ones that fired the missile. He believed the Cubans did. After he found out what happened, he forbade his soldiers from firing missiles.[32]

The American President and the Soviet Premier were crucial decision-makers during the crisis. Nevertheless, "it is a story in which they are informed, misled, persuaded, or ignored by the officials around them, in some cases for better and in some for worse. Almost every day the choices the leaders must make are reshaped by the way information and circumstances are brought to them for action."[33] Had the hawks carried the day in either Washington or Moscow, the outcome of the crisis may have been very different.

As the Model III analysis suggests, real governments and militaries are not rigid hierarchies in which the leader is the puppet-master and others are unthinking automata dancing merrily and predictably at the tug of the string. Subordinates exercise initiative; they disobey orders and instructions; they misinterpret guidance; they backstab; they conform; they participate in group-think; they operate on their own agendas – to mention a few of the ways real people behave in organizations.

During the invasion of France in 1940, General Ewald von Kleist, Commander of Panzer Group Kliest, ordered Heinz Guderian on 15 May to halt his XIX Panzer Corps

after crossing the Meuse at Sedan and establish defensive positions to consolidate the German gains and prepare for the French counterattack. Von Kleist's orders were sound, reasonable, and consistent with the instructions he was receiving from his superiors up to and including Hitler. Guderian, however, believed he had an opportunity to deal the French a decisive blow by pushing west toward the Channel coast. In a series of heated exchanges between the two, Guderian finally convinced Kleist of the wisdom of continuing his attack to the west for another twenty-four hours. Kleist relented but elected not to inform his superiors. It was a clear violation of the orders he received from the entire chain of command. The next day Guderian then proceeded to issue orders to his corps to continue the attack past the twenty-four hour deadline.[34] We will explore this case and the issue of initiative in more depth in the next chapter; but nevertheless, the aggressive German attack to the Channel that arguably changed the pace if not the outcome of the war is best explained by Model III analysis of the actions by those such as Guderian.

What these models suggest is that how friendly and enemy governments and militaries make decisions is entirely more complicated than the unitary rational actor model would have us assume. Bureaucratic procedures, subtle and substantial differences in perspective of influential people, the cognitive maps and lenses of leaders and those who influence them all contribute to the process by which decisions and actions come about. Nevertheless, imagine the difficulty of attempting predictive analysis based on a cognitive model or a Model II or III metric as opposed to the unitary rational actor model. The latter is logical, rational, reasonable, and easy to understand. The former are full of inferences, analogies, predictions of unpredictable behavior, uncertainties, and

apparent leaps in logic. However, the cognitive model and Models II and III are far more powerful and reasonable in terms of understanding how decisions actually get made. Like the completely unreliable weather forecasts for the USAAF, we use the unitary rational actor model for planning purposes, and we might not realize or give a second thought to how unrealistic and how far removed from actual events such Model I forecasts will be.

At the same time, it is important to acknowledge the presence of the truly uncanny whenever we are dealing with human beings making decisions in the chaos, confusion, and exhaustion of combat and conflict. Soon after the successful crossing of the Meuse in May 1940, the Germans continued to press the attack south in order to expand the bridgehead and secure defensible terrain for its protection. An exhausted Hermann Balck, commander of the 1st Infantry Regiment of the 1st Panzer Division, had been fighting non-stop for the past five days and paused to take a rest.

> At any rate, I fell asleep and was awakened by my adjutant. He said to me, "Everything has been done in accordance with the order." I asked, "What order?" He said, "The order to thrust forward." I replied, "That's quite a sound order. Who issued it?" My adjutant responded, "Why, you did." I said, "Not a chance." But, in fact, I had issued the order during my sleep.[35]

Game theory has been useful in illustrating the difference between rational decisions in the abstract and decisions made by real people in the real world. The conceptual models have added detail and clarity to how governments and militaries actually make decisions. Within those frameworks is another level of analysis that explains different strategies people can use to make decisions. Intuitive decision-making that was discussed above is one such decision-model. Analytic models abound as tools to help decision-makers optimize their results. Given the same situation, the choice of

analytic model can lead to fundamentally different decisions.[36] As the example of Balck illustrates, even if we could eliminate the uncertainties of the individual, organizational, and methodological factors involved in each decision, the peculiarities of the human dimension would add one more.

Decisions and Outcomes

Interestingly enough, there is no guarantee that a good decision will lead to good consequences or that a poor decision will inevitably generate bad consequences.[37] Paradoxes, the law of unintended consequences, nonlinearity, and complexity can and often do intervene to break the assumed continuity between quality of decision and quality of outcome. To counter Napoleon's invasion in 1812, the Russians decided to fight the Grand Armée on the frontier. Napoleon, meanwhile, had assumed the Russians would do just that and so moved into the Russian frontier seeking to draw them into a battle. Given the track record of Napoleon, the Russian decision, had it been implemented, would likely have led to another French victory. However, circumstances intervened – many due to poor planning and incompetence on the Russian side – which made a fight on the frontier physically impossible. The Russians simply could not get their armies together to fight a battle, so they had to retreat to the interior in order to buy time for themselves to get organized. Napoleon's decision to fight on the frontier was a good one, but due to circumstances beyond his (and the Russians') control, the battle never took place. Napoleon, realizing he could not simply turn back and go home after invading Russia, pursued in order to fight the Russians as quickly as possible. The pace of Napoleon's pursuit was quicker than the Russians' ability to get the Army together, so

as long as Napoleon was moving east, the Russians had to retreat further into the interior in order to buy time. Finally, the forces met briefly at Smolensk and then at Borodino. After a bloody victory, Napoleon entered a deserted and burning Moscow only to have to retreat back to France during the Russian winter, losing much of his army of 600,000 men in the campaign.[38]

Napoleon's decision to fight on the frontier was a good one, as was his decision to try to draw the Russians into a fight as quickly as possible. After Tsar Alexander revolted from Napoleon's Continental System, the French Emperor could not have ignored Russia and still retained his hegemony in Europe. His apparently appropriate choices in the circumstances led to a nearly unthinkable disaster. Conversely, the decision to fight Napoleon as far west as possible was a poor one. Due to all sorts of undesired behaviors, issues, shortcomings, challenges, and problems, bad decisions led remarkably to a good outcome for the Russians.

Information, Understanding, and Decision-Making

Further complicating the issue of decision is that more information does not necessarily produce better decision-making. The issues of bounded rationality, perceptual lenses, and cognitive maps discussed in Chapter Four about Observation and Orientation apply equally to Decision. As one moves up the cognitive hierarchy to tacit knowledge and beyond -- the realms in which decisions are made -- it becomes apparent that good decision-making has far more to do with the nature of the decision-maker than the information itself.

Information, after all, is a condition of the battlefield. Technology can add volumes to the accessibility of information, but good decision-making is possible only when knowledge is fused with understanding. What decision-makers require most is wisdom and good judgment. These higher cognitive functions make the difference. Information, to be sure, is important, but it is not sufficient for good decision-making. The combination of accurate and timely information and leaders who possess wisdom and good judgment is the potent one. Ultimately the development of wisdom and judgment, not mere information, is the critical point.

The relationship between sound decisions and more or better information is not necessarily linear. The belief that information superiority means a commander has the right information to make the right decision is merely tautological: the issuance of a sound decision justifies the existence of information superiority, so the existence of information superiority must have led to the sound decision.[39] Whether information will lead to sound decisions or not is determined by the decision-maker. A brief example from the German invasion of France in 1940 illustrates the point.

By almost any standard of measurement, the French 55th Division commander, General Lafontaine, had information superiority over his German counterpart, Heinz Guderian, during the battle of Sedan in May 1940.[40] Lafontaine even made a number of sound and timely decisions that mathematically should have prevented Guderian's Panzer Corps from seizing permanent bridgeheads over the Meuse River. Remaining in his bunker located several kilometers from the front, Lafontaine followed the French version of information superiority – the links were by wire rather than cybernetic – believing that

he could orchestrate and win the fight by reading the situation and issuing orders to block German penetrations. His employment of the Methodical Battle concept was textbook.

While Lafontaine and his subordinate commanders were busy making decisions from their bunkers, however, critical portions of the defense were crumbling in subtle ways that defied what should have been the case based on physical reality on the ground. Panicked soldiers and units refused to fight. The psychological breaking point had occurred well before physical reality had caught up. Lafontaine acted to arrest the panic once it manifested itself physically. By that time he was too late. Doctrine and the quest for information kept him and his commanders in their bunkers. So did failures in knowledge, understanding, and wisdom. Further information would not have led to better decisions nor saved the French that day.

Conclusion

Our analysis of decision-making reveals that, like Orientation and Observation, the concept of Decision in organizations is more complicated than an individual's choice of which stock to purchase or whether a fighter pilot should turn left or right in combat. Decision-makers are human, so our cognitive mapping and translucent lenses are integral to decision-making. Military and government staffs, bureaucracies, and subordinate organizations have policies, procedures, and regulations that guide work along processes designed for speed and efficiency. These processes result in output that may or may not be consistent in trajectory or scope with the specific decision the process was enacted to support. Bureaucratic outputs, although they seem like the products of the individual

decision-maker, often take on an autonomous life and logic. The law of unintended consequences is a frequent companion to organizational output in unique, time-sensitive, ambiguous, and stressful situations. As much as they generate predictability in routine environments, they generate unpredictability in environments that deviate from the routine. They are, in short, uncertain. Moreover, subordinate officials play an interesting role in decision-making, the impact of which should by no means be underestimated. At the same time, different people affect decision-making in different ways in different situations. Sometimes we can predict accurately which individual will be influential and how, other times we cannot.

Compounding the uncertainties about the processes and influences on decision-making is the fact that different analytic models exist and that each one can generate a strategy altogether different than an alternate model. Choosing a decision-making tool or strategy is a decision in itself. So even if the decision-maker wants to use tools to add precision, the outcome may be uncertain because the choice of tool will determine it. To predict the decision we would need to know the tool, and the decision-maker is, of course, free to alter or reject the output of the tool, go with his own intuition, or select another tool. Conversely, predictability in choice of tools will lead to predictability in decisions that a thinking enemy will be able to exploit.

Uncertainty is part of the nature of Decision. Information can reduce the simple uncertainties, but coping with the others is a function of the decision maker. Still, the exploration of uncertainty has barely traveled beneath the surface. The next chapters will examine the discontinuities between Decision and Action in the human, nonlinear, and interactive dimensions.

Chapter Six

Uncertainties in Action: The Challenges of Obedience and Initiative

The uncertainties involved in Observation, Orientation, and Decision are profound, but the greatest discontinuities and uncertainties in combat generally occur between decision, action, and outcome. We began to scratch the surface of the problem in the previous chapter in our analysis of decision models and in the paradox that quality of choice does not inevitably translate into outcomes of symmetrical quality. In this chapter we study the complexity of Action in greater detail. Such analysis necessarily begins with the human condition in combat. As we shall see, the movement from Decision to Action is more complex and uncertain than the simple arrow in the Boyd cycle would lead us to believe. In life, and particularly in war, there is no guarantee that a decision will inevitably lead to the actions envisioned and the outcomes intended. In fact, symmetry between decision, action, and outcome might be the exception rather than the rule.

Military plans and decisions ultimately rest on explicit or implicit assumptions that a given organization will accomplish the task assigned to it. In any given battle, however, a significant percentage of military organizations fail to accomplish their assigned tasks; others might accomplish their tasks but at significantly higher cost. Any number of reasons can account for the disturbingly high rate of failure; the most prevalent among them: disparities in will or performance or both between combatants. Military organizations simply fail to conform to mathematical assumptions of effectiveness.

Part of the reason why soldier and unit performance defy mathematical calculations is the human element of war. Military theorists from Xenophon through Clausewitz and Ardant du Picq to the present have recognized the criticality of "moral factors" of war. In the chapter on "Clausewitzian Uncertainty" we defined moral factors in relation to the human and organizational trinities in terms of the physical, cognitive, and psychological domains. The moral factor is the object suspended between the three domains. This chapter focuses on the moral factors as they relate to mission accomplishment.

We have already discussed at length the concept of bounded rationality and how it affects the manner in which we perceive stimuli, make assessments, and conceptualize the future. One interesting element of bounded rationality is that it also applies to the manner in which people respond to orders and instructions. It is useful to analyze the issue of mission accomplishment in war from two related angles. The first angle is obedience: that people will do their utmost to fulfill the orders given to them. The second angle is initiative: the extent to which people will act on their own accord, even in violation of orders, while still attempting to accomplish the task assigned to them. These two angles will provide a framework for examining uncertainties in Action.

Obedience: A General Concept

Military organizations in war function on the implicit assumption that human beings will perform on demand the counterintuitive – they will willingly place their lives in danger because they have been told to do so. The assumption is so implicit that no detailed analysis of the concept of obedience exists in military literature. "Obedience"

here means the desire to completely fulfill of the tasks assigned. In war we assume obedience will lead to success – each task given can and will be accomplished. It would be foolish and wasteful to the point of being unethical to do otherwise. There are circumstances in which the prospect of victory is virtually impossible, but obedience and victory are not the same thing. In desperate situations we still develop plans that have, or at least offer the perception of having, a reasonable chance of success, however that success is defined. Once leaders begin giving the impression, real or imagined, to individuals or organizations that assigned tasks are not possible to accomplish, the very fabric of trust begins to unravel. In return for being assigned reasonable tasks, soldiers and organizations obey. No military could function without assuming such mutual faith in orders and obedience.

To be sure, failure to accomplish a task could be the result of poor planning and decision-making on the part of the senior commanders and staffs. This is indeed a very real problem, but it falls under the previous chapter of uncertainty in decision. To isolate uncertainties in action, we here assume the orders are reasonable: that the soldier or organization has the means to accomplish the task assigned.

Failure to accomplish a task is common in war. Failure comes in two basic forms: unintentional and intentional. Unintentional comes from a lack of understanding or lack of ability to succeed. This can result from problems such as poor communication; physical, cognitive, or psychological inability to accomplish the mission; or superior execution on the part of the enemy. Intentional comes from a purposeful decision to disobey. The following historical vignette is useful as illustration.

Ardennes 1944, The fight at Lanzerath

On the misty morning of December 16, 1944, Lieutenant Lyle Bouck and his Intelligence and Reconnaissance (I&R) platoon observed from their defensive positions German paratroopers entering the town of Lanzerath. With artillery landing behind him in the distance, Bouck telephoned the regimental headquarters to render his report and obtain further instructions. Somewhat doubting the information, the officer responded that Bouck should "hold at all costs."

Opposite Bouck's 18-soldier platoon was the 9th Regiment of the 3rd German Parachute Division. By mathematical calculations, the German lead battalion should have annihilated Bouck's platoon in short order. Human factors, however, intervened to alter the balance. The well-led, cohesive, I&R platoon held off repeated frontal assaults by the less competent and poorly led German battalion. After roughly eight hours of fighting, with dusk approaching and the platoon nearly out of ammunition, Bouck ordered his men to withdraw. An experienced German NCO named Vince Kuhlbach, however, had taken hold of his decimated unit and moved around Bouck's exposed flank, capturing the Americans at gunpoint as they began to emerge from their foxholes to escape west.

Bouck and his men were held captive in a café in Lanzerath where the German regimental commander had established his headquarters. Later that evening, an angry German SS Lieutenant Colonel, Joachim Peiper, entered the café demanding to know why the parachute regiment remained in Lanzerath and had not continued to advance to a critical crossroads several miles further. The lack of progress was delaying the German main attack. The regimental commander replied that the woods were held in at least

battalion strength, fortified with concrete pillboxes and a dense network of minefields. The reality on the ground was that nothing stood between the German regiment and its objective, as Peiper discovered when he decided to attack the mythical American battalion the next morning.

Nevertheless, Bouck's platoon stopped the advance of *Kampfgruppe Peiper* for at least half a day. The fight bought time for the Americans to regroup, for engineers to blow critical bridges in Peiper's path literally minutes before his tanks arrived at them. The engagement set in motion a chain of events that would end with Peiper being bottled up between blown bridges near the Belgian town of La Gleize, and eventually defeated.[1]

This fight is an interesting mix of outcomes, and the complexity enables us to draw a number of salient insights. At one level, Bouck's platoon failed to accomplish the task assigned to them – they did not hold their position. At another level, they succeeded wildly beyond any reasonable expectation. They held their position for roughly eight hours against 27:1 odds overall, 9:1 odds in terms of engaged forces. Either way, by mathematical calculations Bouck and his men should have been annihilated in a matter of minutes. Furthermore, their success set off a chain of events that led to the defeat of the German main attack in the Battle of the Bulge (we will discuss complexity in Chapter Eight).

Bouck understood his orders to hold his position, as unrealistic as those orders might have been, and he had the desire to accomplish them. Eventual failure was due to physical inability. He had no more ammunition. Conversely, the German parachute regiment failed on several levels. Although they eventually captured Bouck and his platoon, they did not seize their objective. Besides Bouck, nothing stood between them

and their objective. Within the regiment, the lead battalion also failed. The Germans were stopped by the American platoon, even though they had the resources to defeat Bouck and to continue on to their objective.

The battalion commander understood his task as well. The unintentional failure was due to lack of ability. Despite having at least 9:1 odds, the battalion was psychologically unable to attack. To be sure, the frontal assault plan was unimaginative, but at 9:1 even a frontal assault should have led to success. Nonetheless, the lack of training and discipline – inadequacy in the physical and cognitive domains -- in the battalion led to immediate and significant casualties. Soldiers lost faith in themselves and their leaders. Psychologically, they simply refused to go any further, until an experienced NCO in whom some of them had faith developed an intelligent plan and was able to lead a small group of soldiers around the flank to capture Bouck's platoon.

The battalion and regimental commanders also may have demonstrated intentional disobedience and either lied or uncritically accepted a false report to justify their inaction. Despite having the physical and psychological ability to continue the attack, the commander halted the regiment. He understood his mission but refused to move on. He either invented the story about minefields, pillboxes, and a US infantry battalion defending to his front, or he accepted uncritically a false report. No effort had been made to reconnoiter the route to their objective, so no one in the regiment could possibly have had any idea what was a few hundred meters to their front. Bouck's platoon, in fact, was in a patch of woods parallel to their route of march. The fact that they were never engaged from any other direction should have been an indicator to them.

Moreover, an intervisibility line along the road would have provided cover and concealment for a recon patrol or even the rest of the regiment to continue on their original line of march during the battle with Bouck's platoon. All they had to do was use the low ground fifty meters on the other side of the road and then move into the woods.[2] In fact, a standard battle drill in German tactics was to send a small detachment to fix the enemy in position and then bypass with the main body. The commander and the entire leadership of the regiment, however, might have been unable to think of such a solution while the intensity and duration of the fight might have made them psychologically unable to continue and accomplish their mission. Nonetheless, what should have been an easy task to obey turned into an instance of unpredictable disobedience and failure that had significant consequences in the outcome of the Ardennes campaign.

Individual Psychodynamics: Paralytic Factors

Moral forces are sources of obedience and lack of obedience in war. Scholars have identified fear, isolation and stress, killing, and the enemy as critical, interrelated factors that can affect individual performance in combat in unpredictable ways.[3] They have also identified courage, leadership, discipline and cohesion as factors that enhance performance. The resultant balance of these combat factors shapes the moral factors of the combatants, and can intervene to alter the mathematical correlations of forces in remarkable ways that are unanticipated and incalculable.

The movement from Decision to Action in the Boyd Cycle possesses the potential for battlefield paralysis. Action requires soldiers to overcome fear and implement decisions. This is what Clausewitz meant by "action in war is like movement in a

resistant element."[4] Fear is one of the constants of war and it takes on many forms. Physically soldiers fear getting killed or maimed. They tend to hide, take cover, bunch up, or simply remain in one spot. Psychologically, there are fears of loneliness, fears of killing, fears of letting one's comrades down, fear of fear.[5] Cognitive fears also exist – fears that plans are inadequate; fears of making wrong decisions that waste one's own life or those of others; fear of losing control of oneself or one's forces; fear of losing.[6] In battle, fear paralyzes soldiers and leaders physically, psychologically, and cognitively. "What battles have in common is human," John Keegan argues, "the behavior of men struggling to reconcile their instinct for self-preservation, their sense of honor and the achievement of some aim over which other men are ready to kill them."[7] At a higher level is moral fear: the fear of losing one's humanity; the fear that the killing, maiming, and destruction are, in the end, for no real purpose.[8]

Isolation can exacerbate the paralytic effects of fear. In *Men Against Fire*, S.L.A. Marshall observed, "The battlefield is cold. It is the lonesomest place which men may share together .... The harshest thing about the battlefield is that it is empty.... It is the emptiness which grips him as with a paralysis."[9] "Internal desertion" can result when soldier feels isolated on the battlefield. "A soldier who has decided to fight no more, who prefers not to desert to the enemy and who can find somewhere to hide may ... sometimes manage to sit out the fighting..."[10] The instinct of self-preservation generally takes over when a soldier feels separated from his comrades.

The feeling of isolation on the battlefield adds to the stress on the soldier. Studies of combat have found that soldiers evidence considerable anxiety about their survival and about how they will perform in battle.[11] The stress that results from anxiety and isolation

has a cumulative effect that leads at some point to combat exhaustion. The tolerance of "normal" soldiers for the stress of combat is finite. According to one study, the chances of becoming a psychiatric casualty in the wars of this century were greater than the chances of being killed by enemy fire.[12]

During the Second World War, some units had psychiatric casualties as high as 34% of total casualties from a battle or campaign.[13] In the first year of the Second World War, "the American army lost more men due to combat reaction than the whole system could mobilize."[14] The size of the Army was, in effect, contracting due to psychiatric casualties. The American official report on *Combat Exhaustion* is instructive:

> There is no such thing as "getting used to combat" ... Each moment of combat imposes a strain so great that men will break down in direct relation to the intensity and duration of their exposure.... Psychiatric casualties are as inevitable as gunshot and shrapnel wounds in warfare.... Most men were ineffective after 180 or even 140 days. The general consensus was that man reached his peak of effectiveness in the first 90 days of combat, that after that his efficiency began to fall off, and that he became steadily less valuable thereafter until he was completely useless.... The number of men on duty after 200 to 240 days of combat was small and their value to their units negligible.[15]

The psychological effects of killing and seeing others killed add to the stress and fear of the soldier. According to Dave Grossman in his influential study *On Killing*, soldiers experience a sequence of stages: concern about killing, the actual kill, exhilaration, remorse, and rationalization and acceptance.[16] If a soldier cannot complete the cycle through rationalization and acceptance, he will likely succumb to combat exhaustion. As a result, the price for increased firing efficiency of soldiers in direct combat with the enemy may have the unintended consequence of increasing the psychiatric casualty rates.[17] "War is an environment that will psychologically debilitate 98 percent of all who participate in it for any length of time," asserts Grossman, "And the

2 percent who are not driven insane by war appear to have already been insane – aggressive psychopaths – before coming to the battlefield."[18]

How soldiers view the enemy can also have consequences on behavior and performance in combat. Studies of World War Two in the Pacific by John Dower and E.B. Sledge, as well as studies of the Eastern Front, emphasize the brutalizing and de-humanizing natures of those struggles.[19] People will continue to "fight to the last man" for a variety of complex reasons, one of which is the fact that they might not see any alternative to death if they fall into the hands of a perceived or actual dehumanized enemy. "The fierce struggle for survival," observed E.B. Sledge, "eroded the veneer of civilization and made savages of us all."[20] The link between savagery and combat performance and outcomes, however, has yet to be studied. Tony Nadal, a veteran of the fierce Ia Drang Valley campaign in Vietnam in 1965, asserted that performance and ethics are not mutually exclusive. "The thin veneer of civilization is easily scraped away in combat, unless the leader is on guard.... The enemy is the enemy until he is under my control. Then he is my *responsibility*."[21] De-humanization is a double-edged sword. It can lead to added resistance, but it can at the same time lead to brutality and atrocities. The result is a vicious cycle: a descent toward inhumanity and a potential increase in psychiatric casualties.

Kinetic Factors of Courage and Leadership

The general trends toward paralysis can also ignite "kinetic" forces such as courage and leadership, and discipline and cohesion. These forces, if channeled properly,

can mitigate the effects of paralysis and generate action. Much like the paralytic forces, however, these are variable over time and dependent upon context.

Fear, Clausewitz wrote, serves physical preservation; courage serves moral preservation. Thus courage is not the absence of fear. Fear will always be present in danger. It simply exists. Courage is a choice. Lord Moran, in his influential study on courage, defines it this way:

> Courage is a moral quality; it is not a chance gift of nature like an aptitude for games. It is a cold choice between two alternatives, the fixed resolve not to quit; an act of renunciation which must be made not once but many times by the power of the will. Courage is will power.[22]

Courage comes in forms similar to those of fear: physical courage, psychological courage, cognitive (intellectual) courage, and moral courage. As Aristotle tells us, it is the mean between the extremes of cowardice and recklessness.

Courage enables us to cope with fear. J. Glenn Gray discusses his experience with fear and the kinetic effects of courage during his experience in the Normandy landings.

> [During the D-Day landings] I crouched under my jeep on a landing craft that went in a few hours after the first waves of infantry. Shells were exploding in the water all around, and I felt sure the next one would land squarely on us. It was silly to expect the jeep to afford any protection against the German 88s, but I could not get up. Then through the tangle of gear and machines I saw an American officer, a captain, standing by the edge of our boat. He was smoking a cigarette, and I watched fascinated as he flicked the ashes into the water. His hand trembled not at all... Then I felt unreasonably grateful to him. It was clear he was exposing himself no more nor less than I; but his reason was in control. I longed to creep through the gear, clasp him around the knees, and look up to him worshipfully... Nevertheless, the sight of him gradually calmed me, so that when our craft reached the shore I was able to get into my jeep and drive it hurriedly through the surf and up onto dry land.[23]

Examples of courage and fear illustrate that paralysis on the battlefield generally remains until some minority of motivated, aggressive soldiers or leaders physically influences the action by taking the fight to the enemy.[24] Such understanding of human behavior led commanders such as Alexander the Great, Caesar, Patton, and many others to wear distinctive dress in combat, and many armies to follow the example of the Romans and carry standards into battle. These easily recognizable leaders and symbols, by their physical presence, proved to be a source of strength to their formations.

Courage is displayed by tangible example. Instances of leaders or soldiers overcoming the paralysis of those around them by force of personal example abound in history. Alexander the Great's soldiers could not bring themselves to scale the walls of a fortress in Asia until Alexander led by example.[25] Caesar's legions would not debark from their ships on the shores of Britain in the face of the enemy until a standard bearer leapt into the surf.[26] Even in modern live-fire training exercises soldiers will hesitate to fire the first round. Once a trusted fellow soldier or leader leads by example, however, soldiers are able to overcome their fear.[27] The bottom line is that leaders overcome paralysis through personal example.

Leadership can also mitigate the psychological effects of fear and stress. One study concludes, "High morale and less stress are found in soldiers, in combat, with confidence in their commanders. This confidence is based on the seen professional competence of the commander, or belief in his credibility, and on their perception of his caring about his troops."[28] Being told to fire, Grossman writes, is the most critical factor in getting soldiers to shoot their weapons.[29] The personal example of the leader, his proximity to the men firing the weapons, and the amount of respect the soldiers have for

him are critical determinants in getting soldiers to kill.[30] Since it is on the leader's command or example that killing generally initiates, the leader plays a key role in the absolution process in which soldiers begin to cope with the effects of their actions.

Leaders and comrades can also counteract the immediate effects of stress reaction in combat. In Lyle Bouck's platoon during the first day of the Battle of the Bulge, one soldier, a stalwart one at that, had gotten up from his foxhole after a fire-fight. He began screaming that he could not take it anymore and was going to run away. Recognizing the potentially demoralizing effect of this act, Bouck got up from his foxhole, tackled the soldier to the ground and threatened to shoot him if he did not return to his position. The soldier, returning to his senses, calmed by his leader, awakened again to his responsibility to his comrades, went back to his position and fought masterfully for the rest of the day.[31]

The Lost Battalion of the First World War is another example of a unit that was sustained psychologically by its leader. This battalion was cut off and surrounded by the Germans but continued to fight on for days. They quickly ran out of food, water, and ammunition. The survivors were ringed with wounded and dead comrades. The Germans continued to attack the battalion, finally resorting to flamethrowers to burn them out. Still their commander, Major C. W. Whittlesey, refused to surrender. After five days the remnants of the battalion was rescued. The soldiers were unanimous in citing their commander as the reason for their will to fight on. Whittlesey earned the Congressional Medal of Honor. He committed suicide shortly after the war.[32]

The psychological strain on the leader in getting people to kill and in coping with his own soldiers being killed can be debilitating, particularly if there is no physical and psychological distance from the killing. "As each of his men is wounded or killed, their

suffering hangs on his conscience, and he knows that it is he and he alone who is making it continue. He and his will to accept the suffering of his men are all that keep the battle going. At some point he can no longer bring himself to muster the will to fight, and with one short sentence the horror is ended."[33] The effect of leadership by example can be paradoxical – soldiers fire their weapons when the leader is physically present, but the physical presence of the leader can exacerbate the psychological trauma of killing and seeing one's own soldiers being killed. Developing psychological courage and the ability to cope with stress and trauma are crucial in sustaining the leader's effectiveness.

Cognitive, or intellectual, courage, in the leader has received little attention in modern studies of the human dimension of war. Clausewitz examines the problem in the most detail and depth. His section on "Military Genius" in *On War* is a powerful testimony to the criticality of intellectual courage. In his paragraph on uncertainty, for instance, he argues the importance of the powers of intellect. A commander must have a "sensitive and discriminating judgment," an ability to "scent out the truth." Intellectual inadequacy, he asserts, will result in indifferent achievement due to the extreme cognitive demands of war.[34]

> If the mind is to emerge unscathed from this relentless struggle with the unforeseen, two qualities are indispensable: *first, an intellect that, even in the darkest hour, retains some glimmerings of the inner light which leads to truth; and second, the courage to follow this faint light wherever it may lead.* The first of these qualities is ... *coup d'oeil*; the second is *determination.*[35]

For Clausewitz, intellectual courage combines vision and determination. The commander must be able to grasp the reality of the situation – its essential truth – and must be able to employ creative genius to employ military force effectively. At the same time, the

commander must balance an open mind in his search for the truth with the determination and conviction to see his decisions through to the finish.[36]

General William T. Sherman's campaigns in the west during the American Civil War are an example of intellectual courage in uncertainty.[37] As Sherman's army began to march deep into Confederate territory, enemy forces raided his extended lines of communication (LOCs). Sherman had to decide whether he would attack toward Atlanta and ignore the threats to his rear, or to focus on the confederate forces interdicting his LOCs, defeat them, and then move on. The former choice entailed considerable risk, but would potentially help win the war more quickly. The latter choice was a much safer but slower course. Sherman's reasoning to drive to Atlanta was an example of intellectual courage in the finest Clausewitzian sense.

> We cannot now remain on the defensive. With twenty-five thousand infantry and the bold cavalry he has, Hood can constantly break my road. I would definitely prefer to make a wreck of the road and this country from Chattanooga to Atlanta[,] ... send back all my wounded and unserviceable men, and with my effective army move through Georgia, smashing things to the sea. Hood may turn into Tennessee and Kentucky, but I believe he will be forced to follow me. Instead of being on the defensive, I will be on the offensive. Instead of my guessing what he means to do, he will have to guess at my plans. The difference will be twenty-five percent.[38]

Grant was not as optimistic as Sherman about the plan's prospects of success. Nevertheless, the latter stuck to his vision and convinced Grant of its wisdom:

> No single Army can catch Hood, and I am convinced that best results will follow from our defeating Jeff. Davis's cherished plan of making me leave Georgia by maneuvering ... unless I let go of Atlanta my force will not be equal to his.[39]

Sherman's ability to grasp the essence of the situation, to make a bold decision in the face of uncertainty and despite pressures to remain on the defensive, and to see the decision

through to the end contributed significantly to the Union victory in the Civil War. One of his subordinates described Sherman's intellectual courage as follows:

> He had the rare faculty of being more equable under great responsibilities and scenes of great excitement. At such times his eccentricities disappeared, his grasp of the situation was firm and clear ... and no momentary complication or unexpected event could move him from the purpose he had based on full study of contingencies. His mind seemed so clear, his confidence never so strong, and his spirit never so inspiring.[40]

Sherman's intellectual courage in the face of uncertainty reinforces nicely the point made in the previous chapter that decision making has far more to do with the quality of the decision maker than the nature of the information. Sherman had a very clear picture of the physical relationships of the battlefield. The information he had certainly could have justified remaining on the defensive. He chose to interpret the information differently and pursue a course that confounded expectations. By ignoring the threat to his rear and pursuing relentlessly his vision, Sherman shaped the duration and outcome of the Civil War.

Organizational Psychodynamics: Comradeship

The strength of cohesion can also affect the performance of individuals and organizations in the environment of war. Like the individual factors, the organizational factors can influence human behavior unpredictably. The impact of the group on the individual is powerful and sometimes works toward obedience and sometimes against it. Group dynamics can be consistent with the goals and orders of the leaders; they can be subtly divergent; or they can pull the individuals in an opposite direction. As levels of chaos increase, group dynamics can take on a life and logic of their own beyond the

control of orders. Obedience to the group can conflict with obedience to positional authority.

Comradeship is one of the critical coping mechanisms against the debilitating effects of fear, isolation, stress, and killing. S.L.A. Marshall contends, "I hold it to be one of the simplest truths of war that the thing which enables an infantry soldier to keep going with his weapon is the near presence or presumed presence of a comrade."[41] In combat, soldiers fight for each other. The fear of letting one's comrades down, of being considered a coward by them, of seeing one of them killed or wounded due to one's mistake, is a critical factor that motivates soldiers to risk their lives in battle.[42] "Numerous soldiers have died, more or less willingly," writes J. Glenn Gray, "... because they realized that by fleeing their post and rescuing themselves, they would expose their companions to greater danger. Such loyalty to the group is the essence of fighting morale."[43] A study of unit cohesion in the *Wehrmacht* published the thoughts of one German soldier:

> The company is the only truly existent community. The community allows neither time nor rest for a personal life. It forces us into a circle, for life is at stake. Obviously, compromises must be made and claims surrendered. Therefore, the idea of fighting, living, and dying for the fatherland is but a relatively distant thought. At least it does not play a great role in the practical motivation of the individual.[44]

Comradeship within the primary group has a strong influence in how the soldier will cope with the physical dangers of battle. It offers relief from isolation, comfort in stress, and absolution for killing.[45] Erich Maria Remarque writes in *All Quiet on the Western Front*:

> These voices, these quiet words, these footsteps in the trench behind me recall me at a bound from the terrible loneliness and fear of death by which I had almost been destroyed. They are more to me than life, these voices, they are more than

> motherliness and more than fear; they are the strongest, most comforting thing there is anywhere, they are the voices of my comrades.[46]

The power of comradeship, with its ability to help the individual cope with war, also holds powerful sway over the soldier's behavior.

Panic

As a part of his larger study of soldiers under fire, S.L.A. Marshall investigated incidents of panic during the Second World War. His analysis led him to the conclusion that more often than not the cause of an unexplained withdrawal, or "panic," was trivial in nature and often only indirectly related to the amount of pressure applied by the enemy. A number of cases began with a sudden and unexplained motion to the rear. The appearance of flight even if it was only a single soldier going to get ammunition or medical attention, led to a presumption that everyone was withdrawing, and resulted in mass movement to the rear.[47] Such panic would stop only when a small group of leaders and soldiers, by physical example and by force, regrouped the fleeing individuals. J. Glenn Gray's experience in World War Two was consistent with Marshall's observations. "The literature of war is replete with instances of elite troops seized with panic fear, of the bravest soldiers fleeing in terror at some time in their career. Cowardice in this sense is, like rashness, a group phenomenon and greatly contagious.... Commanders of troops can never be sure how their units will respond to the effect of surprise or close-contact fighting."[48] The criticality of Clausewitz's observation that all soldiers carry with them the potential for friction is exacerbated by the fact that such friction can be contagious.[49] The flow of information, laterally, downward and upward,

that communicates what is happening, what we are doing, and *why*, is critical in preventing the onset of such panicked movement to the rear.[50]

The key point, however, is not the flow of information itself, but the mutual understanding among each individual about the meaning of information and activity – the *why*. Such understanding has its foundation in what Ardant du Picq calls mutual acquaintanceship.[51] People who know and understand one another well are likely to communicate more effectively than people who are not mutually acquainted. Physical and verbal language has fewer ambiguities among those who know each other well. As we discovered in the previous chapters, people interpret information according to their own perspectives. People who do not know each other well are far more likely to construe meaning from information differently than intended by the sender. Consistency of perspective gained through mutual understanding is crucial in sustaining common sense of meaning.

Cohesion and Discipline

Unit cohesion and discipline work in tandem to sustain the individual and group, control group impulses, and channel individual and group energy in the right direction. In some ways they give direction and larger purpose to comradeship. They aid the forces of obedience in war.

Unit cohesion is the "bonding together of members of an organization in such a way as to sustain their will and commitment to each other, their unit, and the mission."[52] Unit cohesion directs comradeship toward the accomplishment of unit goals. Studies of

cohesion suggest that internalizing values and codes of behavior through competent and trustworthy leaders adds significantly to the reliability of individuals and units in war.[53]

The development and sustainment of unit cohesion, therefore, implies the presence of discipline. The latter can be defined simply as knowing the difference between right and wrong in terms of performance and behavioral expectations, and to do what is right regardless of who, if anyone, is watching.[54] Given the chaos, dispersion, and lethality of the modern battlefield, the criticality of internalized discipline becomes even greater. Lord Moran, a front-line doctor in the First World War, calls it the discipline of persuasion: the discipline that comes from knowing the right thing to do and doing it without requiring coercive authority. Control from within, in which soldiers regulate themselves and their comrades, will sustain soldiers' purposeful activity in combat more reliably than coercive control from external authority.[55]

As we saw with the Lost Battalion, and as many historical examples illustrate, disorder, disintegration, and severed ties between subordinate units and their higher headquarters do not automatically result in panic or loss of will or fighting capacity.[56] Unit cohesion that springs from discipline and comradeship can sustain the will of leaders and soldiers to fight in the most desperate of circumstances. The retention or loss of the will to fight, while influenced in part by an enemy's actions, is really determined by the physical, cognitive, and psychological state – the moral state, in Clausewitz's terms – of leaders and the soldiers.

Evidence of the sustaining power of unit cohesion in war is abundant. During the Second World War, the 85th and 91st Infantry Divisions, outfits that were thrown together quickly and had little time to develop any meaningful cohesion, had 22.7% and 34.0%,

respectively, of their casualties due to combat stress after 44 days of action in Italy. The 82nd Airborne Division, by contrast, had only 5.7% of its casualties due to combat stress after 38 days at Normandy, while the 101st Airborne had 2.0% after 42 days in the Battle of the Bulge.[57] "Cohesion and leadership are the only meaningful forces that can effectively prevent combat reaction and serve as a buffer against the anxiety of combat."[58]

The presence and legitimacy of the leader is crucial in sustaining strong cohesion. One study has determined that casualties can significantly weaken group cohesion, particularly if the casualties were considered "wasteful" because they resulted from poor leadership, inadequate plans, or unreasonable missions.[59] Sustaining cohesion requires faith and trust in one's comrades, in the capabilities of the group, and in the leader.

France 1940

The criticality of discipline and trust and faith in leaders was evident in a situation during the German invasion of France in 1940. Guderian's XIX Panzer Corps had reached the Meuse River by 13 May, three days into the campaign. Guderian planned for six crossing sites. The main effort, the 1st Panzer Division in the center reinforced by the *Gross Deutschland* Infantry Regiment, was to secure two crossing sites. The supporting efforts, the 10th Panzer in the east and the 2nd Panzer in the west, were to secure two sites each as well.[60] The 1st and 10th Panzer Division areas of operation contained cover and concealment from which they could remain hidden until initiating the crossing. The 2nd Panzer area of operations, however, was a flat flood-plain that was dominated by high ground on the French side. Movement by the 2nd Panzer could be detected for several

kilometers prior to reaching the Meuse. On the French side of the river were several concrete emplacements containing anti-tank guns from which observers could fire their weapons and adjust artillery with deadly accuracy.

As the attack across the Meuse began on 13 May, the French identified the movement of the 2nd Panzer quickly and fixated on it, believing it was the main attack because they could see German tanks. The French began hammering the 2nd Panzer with artillery and anti-tank fire, preventing them from getting close to the river. The division's 2nd Brigade highlighted that the attack was "impossible" given the strength of French positions on the opposite side of the river. Nevertheless, the division continued attacking throughout the day. At one point they were even able to get boats into the river, but all of them were destroyed by French fire. The 2nd Panzer Division received the bulk of the French artillery fire and the bulk of the attention by the French command.

Despite the apparent futility of the attack the 2nd Panzer continued to apply pressure to the French throughout the day. Recognizing their role as a supporting attack, they knew that every round of artillery and anti-tank fire they drew was one fewer round on the Corps' main effort. Sustaining such an attack in the face of murderous fire, and with the recognition that crossing the Meuse at such a place was impossible, must have required incredible leadership and unit cohesion. Nonetheless, the division continued to attack, continued to draw the French attention and fire, and enabled the Corps' main effort to secure two crossing sites that afternoon. The 2nd Panzer, in fact, never established a crossing site during the day. The successful attack of the 1st Panzer, which expanded the bridgehead and destroyed from the rear the bunkers overlooking the 2nd Panzer, enabled the latter to establish a crossing site at 2200 that evening.

Obedience in such a situation was critical, both in terms of sustaining the efforts of the division and supporting the efforts of the Corps. 2nd Panzer, in one sense, failed in that they did not establish the crossing site on their own. Their obedience in continuing the effort over the course of the afternoon, however, was crucial to the success of the Corps. Leadership, mutual understanding, discipline, unit cohesion, faith and trust were evident abundantly in the 2nd Panzer Division that day.[61]

Even units with strong unit cohesion, however, are not immune to the effects of combat stress. S.L.A. Marshall relates an incident during the Battle of the Bulge in which an American company, "first-class troops which had fought many successful engagements," had taken Wardin, a town critical in the fight for Bastogne, from the Germans. Operating virtually as a detached force in a chaotic and ferocious fight, this company had every incentive to remain on guard and consolidate their position and prepare for the Germans to launch a counterattack. Within an hour of capturing this critical town, however, the American company was "driven back and scattered, with a loss of half of its strength in killed, wounded, and captured." Rather than consolidating their position, the American company had been rummaging through Belgian houses for food and other loot.[62]

The study of the human dimension of war in terms of individual and organizational psychodynamics suggests that obedience and success in war are by no means certain. Failure can result from honest miscommunication between people, from a lack of capability physically, psychologically, or cognitively, or from simple refusal to obey due to lack of confidence in what an individual or unit is asked to do. Mutual

understanding through active and meaningful communication and acquaintanceship, plus strong unit cohesion that develops from comradeship, discipline, and leadership, are the best ways to set the conditions for reliable performance in combat.

Initiative and Obedience

Initiative creates uncertainty in combat as well, but it differs subtly from obedience. Initiative is related to obedience in the sense of what the American army calls commander's intent. Understanding the commander's intent – the larger purpose of the mission – enables subordinate leaders to exercise independent decision-making in the absence of orders or when existing orders are no longer applicable in the dynamic situation of combat.

The concept of initiative that the American military is comfortable discussing and accepting is the notion of independent decision-making in the absence of orders or when the immediacy of the situation calls for action first before checking with superiors. We discuss only this type of initiative, and indeed celebrate it, at least in professional literature.

Unnoticed up to this point has gone the more problematical side of initiative: the direct and knowing disobedience of orders with the purpose of accomplishing the commander's intent. This type of initiative results from a disagreement between senior and subordinate over the best course of action to accomplish the commander's intent. The subordinate, in this case, follows his own plan fully understanding the direct orders of the senior commander to the contrary. It is, in a sense, intentional disobedience to some orders for the purpose of obedience to others. This type of initiative is practiced by

willful and self-confident subordinates. They are convinced they have the best understanding of the situation and the best plan to solve it. It is practiced, in many ways, by the very types of leaders the military prides itself on developing.

France 1940

Three such incidents occurred between XIX Panzer Corps Commander Heinz Guderian and Panzer Group Commander Ewald von Kleist in May 1940. In developing the plan for the Meuse crossing, Kleist wanted a simultaneous attack across the river by his two Panzer Corps: Guderian's XIX and Reinhardt's XLI to Guderian's west. On 11 May he ordered Guderian to cross the Meuse with his main effort west of the Ardennes Canal (where 2nd Panzer would in fact try to cross) so he could make the efforts of the two Corps mutually supporting. Guderian, however, wanted to cross east of the canal, and deliberately moved his forces toward the Meuse on 12 May to facilitate a crossing to the east.

Kleist noticed Guderian's move and called the latter to account. In a meeting between the two commanders, Guderian, after failing to convince Kleist of the wisdom of attacking east of the Canal, announced to Kleist that his Corps would not be ready to attack until 14 May because he would have to shift his forces. Kleist recognized the *fait accompli* and relented. Guderian's choice was better for the XIX Corps than Kleist's, but Kleist's reasons for wanting the main attacks of his Corps to be mutually supporting in time and space were reasonable from a Group perspective. Guderian's selection of where to cross was better than the area selected by von Kleist, as the experience of the 2nd Panzer would illustrate. Indeed the results of the fight turned out very well for both the

Group and Guderian's Corps. Nevertheless, Guderian deliberately disobeyed clear orders and manufactured a *fait accompli* according to his own wishes. Had he done otherwise, the outcome of the 1940 campaign might have been very different. Even as it was, Guderian regarded the successful crossing as "almost a miracle."

The second incident between the two of them was similarly problematical. Once Guderian's forces had crossed the Meuse and had penetrated French defenses to the south, the defending French 55th Division disintegrated in panic. Guderian's Corps continued the attack south toward the heights at Stonne and expanded the bridgehead west toward the XLI Corps. The strength of Guderian's penetration across the Meuse, however, was less than met the eye. Early on14 May, XIX Corps had only five battalions across the river. Nevertheless, Guderian was intent on pivoting and heading west rather than consolidating his Corps across the river first before moving on. Despite indications of a major French counterattack coming from the south toward Stonne, Guderian issued orders to the exhausted 1st Panzer Division to pivot west and advance approximately 43 kilometers over the next two days.

The division acknowledged the order, but the daily log noted doubts about the wisdom of Guderian's plan. Division reconnaissance forces had run into strong resistance in the proposed direction of the attack; the division's armor brigade reported heavy casualties in soldiers and equipment. "Many officers have been killed or wounded. Only a quarter of the tanks can still be counted on as combat ready. The lack of ammunition and fuel makes itself particularly noticeable." Given the situation, the division made the following assessment:

> The leadership of the division is faced with the problem of whether to remain with the mission and pivot to the west without regard to the threat from the woods

> north and west of Stonne [the direction of the expected French counterattack], or whether the enemy should be beaten there before pivoting toward the west. The decision is difficult.
>
> If the division pivots immediately, it would offer its flank and rear to the enemy... Relief by [other units in the Corps] could not be expected....
>
> On the other hand, the entire plan is at stake. Looking at it from the larger perspective, the division has to pivot to the west whenever any opportunity to do that presents itself....[Given the slowness of the French, it is possible that the exhausted *Gross Deutschland* Infantry Regiment can hold at Stonne until another division arrives to protect out flank]....
>
> Based on the overall situation and trusting in the slowness of the French movements, the division therefore decides to pivot to the west with the bulk of its forces in order to initiate a further advance the next morning.[63]

This truly amazing entry into the division log contains interesting insights. First, the division leadership was clearly concerned about the physical state of the division and whether it could do what the Corps was asking of it. Second is the extent to which the division commander felt he had a vote. Perhaps Guderian had developed a plan and asked the division for a feasibility assessment, perhaps the division commander felt he could tell Guderian that the division could not or should not do as Guderian ordered them to do, much like Guderian had done to Kleist. Ultimately the division leadership accepted Guderian's order and even played a role in convincing him to put another of the Corps' divisions into the pivot west rather than leaving it to defend the southern flank.[64] The value of honest assessment from the divisions in the eyes of the Corps is clear from the log, as is the willingness of the division's leadership to take responsibility in advance for a decision they could have otherwise easily laid at the feet of Guderian had the attack failed.

Before proceeding west Guderian had to convince von Kleist of the wisdom of pivoting and attacking west before consolidating south of the Meuse and defeating the impending French counterattack. As reports of a French armored and motorized division

moving toward Stonne came in on the night of 14-15 May, Kleist wanted Guderian to consolidate and focus on defeating the French counterattack. In what an authority on the campaign describes as the "sharpest exchange of the entire campaign," Kleist finally acquiesced in Guderian's very risky plan to pivot west and attack with two divisions while defending the German southern flank with the the 10th Panzer Division and the depleted *Gross Deutschland* Infantry Regiment. He allowed Guderian to continue west for another twenty-four hours. Nonetheless, Guderian continued to complain about "faint-hearted higher headquarters."

Problems with the plan arose as Twelfth Army, Army Group A, and the German High Command learned that instead of having the bulk of the XIX Panzer Corps across Meuse, Guderian had only five battalions early on 14 May. Twelfth Army relayed to von Kleist the intentions of the German High Command: "move strong forces over the Meuse and then execute an attack in a westerly direction." A subsequent order to von Kleist read "under all circumstances to halt" and "arrange" forces to "counter an eventual counterattack by strong enemy forces."[65] The language of the orders shows the High Command clearly intended a two-step process: complete movement of the Corps over the Meuse, *then* attack west. Guderian, however, remained determined to execute both steps simultaneously. He, in effect, chose to interpret the order as reading *and* instead of *then*. Kleist, having already approved Guderian's plan, was not willing to use the new orders from Twelfth Army to stop him. By providing top-cover for Guderian, Kleist was now exercising initiative in direct disobedience to clear orders. Historian Robert Doughty observes:

> Guderian was thinking in terms far broader and far deeper than anyone in the chain of command above him, and his decision – with von Kleist's reluctant

> concurrence – to leave large but nevertheless minimum forces on the southern flank, pivot west, and then drive deep into French territory included a degree of risk that was undoubtedly unsettling to higher-level German commanders. In reality, they probably did not know a great deal about the detailed situation of the Corps. If the Twelfth Army, Army Group A, or the High Command in Berlin had been better informed, particularly about the condition of the 1st Panzer Division and the degree of risk involved, their fears would have been much greater, and they undoubtedly would have ordered Guderian to halt.

A halt, which might have enabled the French to regroup and re-establish equilibrium, might have altered subtly or even fundamentally the outcome of the campaign.[66]

The third incident occurred just a few hours later. With the leeway given to him by von Kleist, Guderian pushed as far as he could on the 16th of May. Despite direct orders from Kleist to halt after twenty-four hours, Guderian issued orders to his Corps to continue the advance the next day. The orders were monitored by a German radio intercept unit and reported to Kleist. The latter met Guderian at an airstrip and reprimanded him for disobeying orders on several occasions. Kleist had covered for the impetuous Corps commander long enough. Guderian refused to accept the reprimand and submitted his resignation. To everyone's surprise, von Kleist accepted it. In the event, the Twelfth Army Commander General List met Guderian and informed him that his resignation would not be accepted. He allowed Guderian to launch a "reconnaissance in force." Recognizing he could manipulate such orders as he saw fit, Guderian continued to attack aggressively to the west. He also had a land-line laid from his main command post to his forward command post so his orders could not be monitored any more.[67]

Initiative and Uncertainty

One wonders, indeed, whether Guderian's attack would have been possible sixty years later. With the increased transparency of the battlefield in the 21st century, would the German High Command – knowing of the approach of two French Divisions against a vulnerable southern flank, knowing the friendly situation, and the desire of a rambunctious subordinate to attack into the heart of enemy territory with exhausted and depleted forces – have ordered a halt? Information, in the creative realm of uncertainty, may be a two-edged sword.

Initiative – arguably an article of faith in the American military, certainly in the Army and Marine Corps – adds to the uncertainty of war. Initiative is taken in the spirit of obedience to the commander's intent or the goals of the campaign or battle. Initiative, however, does have an interesting paradoxical quality in that it can result in direct disobedience to reasonable orders in the spirit of obeying a higher purpose. Guderian was very comfortable operating in that realm. Von Kleist, up to a point, had the stomach for it as well, particularly as he had a golden opportunity to put the wraps on his subordinate when new orders arrived from Twelfth Army. Guderian finally pushed him over the edge after ordering his Corps to continue attacking after Kleist had taken a risk for him the previous day. Neverthless, von Kleist chose disobedience as well.

These cases of willful disobedience under the auspices of accomplishing higher intentions or goals were successful in the end. Such is not always the case. Jeb Stuart's initiative prior to Gettysburg had disastrous results. The cavalry commander's independence robbed Lee of critical information on the enemy situation and terrain in the

area of operations, and certainly set the conditions for, and contributed significantly to, the Confederate defeat in that campaign.

Initiative can lead to orders of magnitude greater performance in combat. It can enable subordinate leaders to exploit immediate and fleeting opportunities in a fluid battle, campaign, or war. It can also beg moral, ethical, and professional questions that we have up to now failed to explore. Subordinate leaders in the past could evade the problem by simply not reporting information until their initiative became a *fait accompli*. Today, with the growing physical transparency of the battlefield, such obfuscation is increasingly impossible. To value initiative ultimately means to value disagreement and a degree of disobedience.

Conclusion

In the final analysis, the human dimension of "Action" in the Boyd cycle contains uncertainties that remain hidden despite information on the physical locations and dispositions of friendly and enemy forces. The moral factors, the resultant synergy of physical, psychological, and cognitive domains, are the true measure of combat capability. Such immeasurable strength, although one can perhaps estimate it very roughly, is dynamic. It is fluid over time and space and over intensity and duration of combat. It is dependent on intangible elements such as leadership and unit cohesion. Such moral factors also influence whether orders will be obeyed or not and how lack of obedience will manifest itself during the fight. They also influence the nature of initiative: whether it will be taken or not, whether it will be consistent with orders and intentions, whether it will result in disobedience to some orders in order to obey others

more effectively, and whether such disagreement and judgment on the part of a subordinate is tolerable. In sum, there exist discontinuities between decision and action in war.

Studies of the human dimension of combat illustrate vividly the very real and very common effects of true uncertainty in war. The assumed continuity between decision and action is illusory. Some units elect to ignore orders or alter them to capitalize on a perceived opportunity. Others disobey because they believe a certain task is doomed to failure. Other problems arise when subordinates understand the intention of the commander differently than the commander had anticipated. Sometimes soldiers simply refuse to follow the orders. Many units simply fail to perform to expectations due to poor execution on their own part or superior execution on the part of the enemy. Still other units perform wildly beyond expectations. The result is that war is a human endeavor that rarely conforms to neat mathematical calculations. Each mathematical irregularity creates unforeseeable crises in war with which commanders must cope as well as opportunities they can exploit.

Chapter Seven

Nonlinearity and Chaos in War

Chapter Six examined the discontinuities between decision and action. This chapter analyzes the related problem of why the decisions we make and the actions we perform can generate immediate outcomes that defy predictability. The uncomplicated and symmetrical progression from decision to action to outcome assumes that the world operates strictly according to linear logic and science. Certainly linear outcomes do occur. As we have begun to explore, however, war can produce results that defy the certainty and intellectual comfort of linearity. This phenomenon is known as nonlinearity.

Nonlinear Theory

Nonlinear dynamics is a branch of science that seeks to explain why systems in the real world routinely do not respond as predicted by classical mathematics and Newtonian physics. A linear outcome is one in which the strength of the input yields a symmetrical strength of output. A nonlinear outcome is one that is not directly proportional to the input.[1] Nonlinear systems, as historian Alan Beyerchen explains, "are those that disobey proportionality or additivity. They may exhibit erratic behavior through disproportionately large or disproportionately small outputs, or they may involve

'synergistic' interactions in which the whole is not equal to the sum of its parts."[2] In a nutshell, a nonlinear outcome is one that defies the logic and science of linearity.

Nonlinear systems are living, animate, and adaptive. They change over time and with context due to interaction. Nonlinear systems also have feedback loops that help induce adaptation. The feedback from interaction serves as an input to the system. The adaptation of the living, animate system that results from feedback can cause gradual as well as abrupt change over time. The alterations that result transform the system into a qualitatively different nature or regime of behavior. Nonlinearity helps to explain why even subtle inputs to the system can yield disproportionately large outputs, and vice versa. Nineteenth century scientist James Clerk Maxwell explains the limitations of seeing the world solely through the straitjacket of linearity:

> When the state of things is such that an infinitely small variation of the present state will alter only by an indefinitely small quantity the state at some future time, the condition of the system, whether at rest or in motion, is said to be stable; but when an infinitely small variation in the present state may bring about a finite difference in the state of a system in a finite time, the condition of the system is said to be unstable. It is manifest that the existence of unstable conditions renders impossible the prediction of future events, if our knowledge of the present state is only approximate, and not accurate... it is a metaphysical doctrine that from the same antecedents follow the same consequences. No one can gainsay this. But it is not of much use in a world like this, in which the same antecedents never again concur, and nothing ever happens twice.... The physical axiom which has a somewhat similar aspect is "That from like antecedents follow like consequences." But here we have passed from sameness to likeness, from absolute accuracy to a more or less rough approximation.[3]

In a nutshell, even subtle changes to initial conditions in an unstable system can lead to outcomes that defy proportionality. The same input can also yield different outcomes at different times because they nature of the system is dependent upon context.[4]

Single inputs, however subtle or dramatic, are often not enough to generate nonlinear outcomes. The living system adapts to its environment. It recovers from inputs and tries to resume normal patterns of behavior. The nature of the system determines to what extent it can recover. A strong, resilient system can re-establish and sustain equilibrium more effectively than a brittle or fragmented one.

A system that responds proportionately to input is linear. A system that responds disproportionately is nonlinear. Such a system can restore equilibrium or sustain effectiveness despite an input that should, by linear calculations, destroy it or render it ineffective. It has the resilience to adapt, recover, and continue to function. Conversely, a fragile system can unravel due to a small input. For whatever reason, it is unable to recover and resume normal behavior.

Systems are often subject to multiple rather than single inputs. The capability to recover from a series of inputs is the true test of the system's resilience. Nonlinear outcomes result when the system continuously recovers from disproportionately large inputs. Nonlinearity also occurs when a system is unable to recover before the next set of inputs.[5] Such behavior is chaotic. The outputs seem to be random rather than predictable and deterministic.

Military organizations often exhibit nonlinearity. The quality of leadership, for instance, can have a significant impact on the combat effectiveness of an organization. As the quality of leadership changes over time, the organization can demonstrate very wide ranges of effectiveness. Combat stress on a unit can also become transformational. What was a superb outfit after two weeks in combat can become a dysfunctional one after two months at the front. The nature and magnitude of the change due to inputs is

dependent upon the nature and resilience of the system itself. Cohesive organizations are likely to resist dysfunctional change longer than brittle or fragmented ones.

Soldiers and military organizations in combat fit the definition of a structurally unstable system.[6] Initial conditions of the defining moral factors: physical, psychological, and cognitive, are dynamic. They change over time and with context. Interaction generates feedback in the system. The moral factors alter their shape and balance due to interactions with self, friendly forces, the enemy, and the external environment. The interactions combine to produce unique outcomes in war. In short, each battle outcome is unique to its context. It can never be replicated precisely. As Beyerchen summarizes, "The heart of the matter is that the system's variables cannot be effectively isolated from each other or from their context; linearization is not possible, because dynamic interaction is one of the system's defining characteristics."[7]

One powerful example of nonlinear behavior comes from Samuel Huntington's *Clash of Civilizations*:

> More generally, even small amounts of violence between people of different civilizations have ramifications and consequences which civilizational violence lacks. When Sunni gunmen killed eighteen Shi-ite worshippers in a mosque in Karachi in February 1995, they further disrupted the peace in the city and created a problem for Pakistan. When exactly a year earlier, a Jewish settler killed twenty-nine Muslims praying the in Cave of the Patriarchs in Hebron, he disrupted the Middle Eastern peace process and created a problem for the world.[8]

In this case, context was absolutely crucial in generating nonlinear behavior that disrupted the already fragile peace process in the Middle East.

Nonlinearity: Lanzerath, Ardennes, 1944

The fire-fight between Lyle Bouck's eighteen-soldier platoon and the German parachute infantry battalion on December 16, 1944, is an example of nonlinearity in war. The systems – in this case the American platoon and the German battalion – were sensitive in different ways to initial conditions (the moral factors). As the interactions iterated and generated feedback into the systems, each one responded in ways that defied additivity and proportionality. The moral factors of Bouck's platoon made it more resilient to the interactions. Resolve, in fact, may have strengthened over time as the platoon beat back successive frontal attacks. The platoon sustained system equilibrium literally until it ran out of ammunition (change in physical domain) and was then surprised by German soldiers who had moved undetected around their flank and took them prisoner at gunpoint as they began emerging from their foxholes to withdraw. At that point resistance was impossible and unthinkable (changes in physical, cognitive, and psychological domains).

From the German perspective, the battalion (and the regiment) should have overrun Bouck's platoon in a matter of minutes. The battalion's initial conditions were quite sensitive to input even as small as Bouck's platoon. As the interactions continued, resolve in the battalion declined. The Germans were in disequilibrium; their system was not robust enough to recover. The frontal attacks were devastating on the physical condition of the battalion, on the psychological state of the soldiers, and the cognitive state of the commander who sat in shock by mid-afternoon. The interactions affected the parachute regiment's commander as well. He was resigned to remain in Lanzerath and was unable and unwilling to think of any solution to accomplish his mission.

Yet another input occurred with disproportionate results. An experienced and respected German noncommissioned officer named Vince Kuhlbach took charge of the situation from the company and battalion commanders, overcame the psychological demoralization of a group of soldiers, and led them around Bouck's flank resulting in the capture of the American platoon.

The Germans oscillated from a state of disequilibrium in the battalion to one of equilibrium in a small group. Bouck's platoon, meanwhile, oscillated from equilibrium in the face of seemingly overwhelming inputs to disequilibrium against a significantly smaller input when the conditions of his force changed. What makes little sense according to classical mathematics becomes comprehensible when analyzed according to nonlinear theory.

Chaos Theory

Chaos Theory is a relatively new and complex branch of science and mathematics, the implications of which for human systems have only begun to be explored.[9] Chaos contends a certain complex order in a system that is determined by each element within it and each force that acts upon it. Elements within the system interact with one another and with external inputs to the system. They also interact with the "feedback" from the first interactions, creating "system perturbations" (subsequent orders of effects) that shape the system and make it unpredictable. The result is a peculiar order unique to each Chaotic system.

Chaos does not necessarily imply disorder. A Chaotic system can be stable or unstable. A Chaotic system is stable if "its particular brand of irregularity" persists in the

face of disturbances (inputs) or if it returns to its particular brand of irregularity over time. The inputs can create responses from the system that are immediately unpredictable but stable over time.[10] Conversely, a Chaotic system is unstable if inputs result in a permanent change in its regime of behavior or nature.[11] Chaotic systems are thus complex and deterministic.[12] Because of the system's complexity, predicting the precise impact of an input or interaction with absolute fidelity is impossible.

War is a Chaotic system.[13] A potential danger exists, however, in believing that deterministic systems are inherently predictable. This is the case only under very specific circumstances. In a nutshell, if you know precisely the initial conditions of a bounded system, you can create behavior that appears random but is, in fact, predictable.[14] Applying repeated taps on a dripping water faucet, for instance, will change the predictable rate and pattern of drops into one that seems chaotic. If you know precisely the initial conditions, and know precisely the nature and timing of the taps being applied to the faucet, you can predict the pattern of the drips.[15] Such a system is both deterministic and predictable.

It would be a mistake, however, to apply uncritically the notion that war as a Chaotic system is both deterministic *and* predictable. First of all, the initial conditions are the moral factors. Calculating them precisely is impossible. Furthermore, these moral factors are fluid and dynamic. Even if we could measure precisely the initial conditions of a unit in a specific place and moment of time, those initial conditions would be different at the next measurement.[16] The ability of an organization to recover from inputs at one moment in space and time is different than its ability to recover in another context. Just because one set of actions produced a nonlinear outcome at one point in time by no

means guarantees that same set of actions will produce a similar outcome in a different context.

Moreover, the "system" in war is not bounded. It is not hermetically sealed from uncontrollable influences. We cannot isolate combatants from internal and external inputs like scientists can isolate a single variable in an experiment. Because the nature of war and the nature of combatants are fluid and dynamic, replicating a situation precisely is not realistic. The internal and external influences on combatants in the particular space and time can alter fundamentally the response to stimuli. The system by its very nature is unpredictable.

It is important to understand that outcomes for human systems often defy predictability.[17] People are shaped by their experiences, by their biases, and by their environment, but they do possess free will. Decisions are shaped in some ways, but they are not determined in advance – you cannot remove agency from war. Free will is perhaps the greatest source of uncertainty. A combatant can set the conditions for a certain response from the enemy, but those conditions are not sufficient for inevitability. The combatant's will is the final arbiter in war. Any theory or model that fails to account for it is fundamentally flawed.

Clausewitz and Nonlinearity

Clausewitz saw war as inherently nonlinear. While it would be misguided to argue that Clausewitz anticipated nonlinear dynamics and Chaos theory, it is reasonable to illustrate how he conceptualized war as a phenomenon that defied linear modeling and

predictability.[18] It is also worthwhile to explore areas Clausewitz did not in order to further refine our understanding of war. Since this chapter examines interaction, it focuses on that theme to illustrate nonlinearity in Clausewitzian thought.

Interaction and Friction

Clausewitz argued that war is not the action of two lifeless forces, or the action on a living force against a lifeless mass, but "always the collision of two living forces."[19] The nature of these living forces is determined by moral factors that defy strict mathematical calculations and probabilities.[20] War, therefore, is like a duel – not a duel with swords or pistols, but a duel between wrestlers. The German word *zweikampf*, that Clausewitz uses, means "two-struggle." A duel between wrestlers generates bodily shapes and contortions due to mutual interaction and struggle that would not be possible with one wrestler alone.[21] The metaphor is incomplete, however, if taken merely as two physical specimens interacting with one another in isolation.

Interaction occurs with self simultaneously with enemy. The wrestler is trying to out think his opponent, to anticipate the moves of his foe and counter them while at the same time attempting moves and holds on his opponent. The physical exertion is accompanied by mental and psychological exertions that increase as the struggle intensifies. In war, this match is not merely for the pin, but to the death in combat.

The cognitive and psychological domains are further problematized by the fact that there are times during the interaction in which the wrestler can escape or hide from the opponent (or at least believe that he can). There is a way out other than death at some points. The instinct for survival that is in delicate tension with the demands of

comradeship can create frictions. As we explored in Chapter Six, the human dynamics of war can result in moments of inertia in which action is stagnant. It can also exacerbate the so-called herd instinct that can generate both meaningful and dysfunctional activity.

The metaphor, therefore, is still not complete. Instead of a single wrestler we now have many of them. Some are on our side, some on the enemy's. Sometimes the teammates work in concert against their opponents, sometimes at cross-purposes. Each of them individually and as a member of the group carries the potential for friction that "may chance to delay things or make them go wrong."[22] The interactions with our teammates, and the enemy's interactions with his teammates, add further complexity to the struggle. We are influenced mightily by the actions and the moral factors of others. "War is a pulsation of violence," writes Clausewitz, "variable in strength and therefore variable in the speed with which it explodes and discharges its energy."[23]

The metaphor needs further refinement because the wrestlers are not isolated from the environment. There are people shouting directions at them and even punishing them if they do not comply. They argue back and forth with them. They listen and ignore. They may follow directions whether it suits their better judgment or not, or they may disobey. Sometimes these shouts are encouraging, sometimes demoralizing. Each interaction, however, affects the wrestlers in some way.

There are other sources of input from the environment: the weather, the terrain, noncombatants, allies, and third party observers whose intentions are not clear. The enemy wrestlers are subject to inputs from similar sources, although the inputs themselves can be unique in the nature and effect. The interactions differ in subtle and dramatic ways from previous experience. They shape the conflict and affect the moral

forces of the wrestlers. "... The same political object [for instance] can elicit differing reactions from different peoples, and even the same people at different times.... Between two peoples and two states there can be such tensions, such a mass of flammable material, that the slightest quarrel can produce a wholly disproportionate effect."[24] Each struggle is inseparable from its unique context.

The wrestlers are not necessarily the Greco-Roman type. Sometimes the struggle is hand-to-hand, but in modern war the grappling takes place at distance. The energy, the pulsations of violence that emanate from myriad sources, causes the ever-changing distortions at a distance. Combatants try to understand the ebb and flow of the distortions. Leaders and individuals on both sides make decisions to remedy problems, exploit perceived opportunities, and shape the future.

The actions that result from those decisions, however, are never quite as they anticipate or intend. There is constantly a divergence, at times slight and almost imperceptible, at times wide and inescapable, between expectations and outcomes. Further decisions are made to help bring outcomes back in line with initial expectations, but the actions result in discontinuities once again. The longer term effects and outcomes, meanwhile, sometimes seem closer to realization, sometimes further away. At once they appear achievable, then they seem unrealistic. Frustration, elation, confusion, clarity enter the minds of the combatants singly and in combination at varying duration and intensity. "War moves on its goal with varying speeds; but it always lasts long enough for the influence to be exerted on the goal and for its own course to be changed in one way or another."[25] The calculations that seemed so logical and precise before the fight now seem completely inadequate. Expectation and outcome diverged for reasons

not entirely apparent, calling for new assessments, calculations, and adjustments. But yet again the cleanliness of linear logic will fail to withstand the test of interactions.

Interaction and Equilibrium

The remarkable trinity lends further insight into the nonlinearity of war. War's three tendencies: passion, probability and chance, and reason, act as three powerful magnets. A theory of war, according to Clausewitz, must maintain a balance between them, "like an object suspended between three magnets."[26] As Beyerchen explains, an object suspended under one magnet will come to rest quickly; when suspended between two it will swing toward one and then the other but still settles into a rest position.

> But when a pendulum is released over three equidistant and equally powerful magnets, it moves irresolutely to and fro as it darts among the competing points of attraction, sometimes kicking out high to acquire added momentum that allows it to keep gyrating in a startlingly long and intricate pattern. Eventually, the energy dissipates under the influence of friction in the suspension mountings and the air, bringing the pendulum's movement asymptotically to rest. The probability is vanishingly small that an attempt to repeat the process would produce exactly the same pattern. Even such a simple system is complex enough for the details of the trajectory of any actual "run" to be, effectively, irreproducible.[27]

Because of the instability in the system, the pattern would never be quite the same in subsequent experiments.

The metaphor, however, must be "modified in practice," to paraphrase Clausewitz. The magnets are "variable in their relationship with one another."[28] The passions vary over time due to the ebb and flow of war. Commanders and their military forces change, which affects probability and chance and the creativity and options available. Policies and goals change in war as it progresses, sometimes getting larger and other times contracting. The pendulum, therefore, is perpetually in motion.

The system is not sealed from outside influences. If each organization in war has its own remarkable trinity as discussed in Chapter Two, then war can be seen as a clash of nested trinities, each exerting force on the other due to interaction. The forces that impact the system are impossible to measure and are ever-changing due to the human factors. These forces affect the system as a whole as well as the strength of the magnets themselves. Interactions with self, others, the enemy, and the external environment make the trinities of trinities dynamic. The results are too complex, too dependent on the dynamic conditions, to be replicated precisely.

If the object suspended in the trinities is the nature of the war and the nature of the combatants, then Clausewitz's concept of "balance" between three magnets takes on additional meaning. The three points of attraction pull at the object simultaneously, forming complex interactions with one another.[29] Maintaining a balance implies equilibrium. Coping with the unstable nature of war means maintaining equilibrium in the system. Disequilibrium results in chaotic and wild oscillations in the pendulum, implying a "nature" that is out of control. Sustaining equilibrium requires active maintenance of the delicate balance between dynamic attractors; creating disequilibrium implies manipulating the strength and balance between the three attractors. We want to create and maintain equilibrium on our side while creating and sustaining chaos for the enemy. This powerful metaphor, while incomplete and requiring modification as do all metaphors, nevertheless is designed deliberately to illustrate war's unpredictable, uncertain nature. We will return to the themes of equilibrium and balance in Chapter 9.

The bottom line is that Clausewitz saw clearly and argued explicitly that war is not imprisoned within the iron bars of linear science and logic. The apparent

contradictions and qualifications that make *On War* so difficult to digest and so misunderstood gain some conceptual clarity when analyzed from the nonlinear perspective.

Chaos in War

When Clausewitz's observations are fused with concepts such as bounded rationality in observation, orientation and decision, and individual and collective psychodynamics in action, we can further appreciate the disparities and discontinuities of war. Decision translates into actions often unforeseen and unintended; actions generate outcomes that are not linear or predictable; and outcomes have effects different than those intended and result in others unanticipated. Smart decisions do not always lead to good outcomes. The clashing of nested trinities generates nonlinearity.

Chaos from Above

Chaos in war can be a top-down phenomenon. Chaotic behavior in these cases generally results from cognitive imbalance – from being out-OODA-looped. Clausewitz describes the process as follows:

> When one is losing, the first thing that strikes one's ... intellect is the melting away of numbers. This is followed by loss of ground.... Next comes the break-up of the original line of battle, the confusion of units, and the dangers inherent in retreat.... The feeling of having been defeated, which on the field of battle had struck only the senior officers, now runs through the ranks down to the privates.[30]

In this case, defeat, while resulting from physical effects on the battlefield, begins in the mind of the commander. The commander sees chaos, finds himself unable to cope

effectively, and at some point loses the will to fight. The loss of will trickles down consciously or subconsciously through the ranks.

Such chaotic behavior originating from above was evident in the engagement between Bouck's platoon and the German parachute battalion. Demoralization in the German ranks began due to loss of will from the commander and lack of faith in him from the troops. The situation was salvaged only when Sergeant Kuhlbach took matters into his own hands and captured Bouck's platoon from the rear. Chaos originating from above was, in this case, mitigated by equilibrium from below. Still, neither the battalion nor the regimental commander was psychologically or cognitively able to continue the mission after the fight.

At the same time, equilibrium from above was evident in the American platoon. Despite the urge on the part of the soldiers to withdraw, and despite the attempt by one of them to run away, Bouck's leadership sustained the platoon in the face of overwhelming odds. His leadership was reinforced by success against the Germans in the engagements. The platoon's ability to remain a balanced and effective force against a disproportionately large enemy is an example in which nonlinearity was illustrated by resistance to chaos.

Chaos from Below: France 1940

Chaos can also originate from below and bubble upwards until the commander finds the situation to be completely out of his control. The subtle effects of psychological collapse from below can be difficult to discern and can lead to the implosion of the organization before physical reality on the ground catches up. Organizations in which the leaders are detached or not trusted are particularly susceptible to chaotic effects that

begin at the ground level and oscillate up the hierarchy to the leaders. One example is the collapse of the French 55th Division at Sedan in May 1940.

The French doctrine of methodical battle called for commanders to be at their command posts, detached from their frontline units, but connected to them by wire or radio. The commander would manage the battle by keeping his hands "on the handle of the fan." He would manage the movement of troops and logistics by maintaining the detached situational awareness afforded by the command post that was connected remotely to his subordinate units by wire.

Such situational awareness and ability to communicate rapidly with the front line and reserve forces would enable the commander to make calm, rational decisions and communicate them instantaneously to his subordinates. The commander could shift forces at the front if necessary to cover a weakness. If the enemy penetrated the initial defensive line, methodical battle doctrine called for artillery to provide a "curtain of fire" to weaken the attacker and slow his momentum, and then a strong reserve would be employed to hit the attacking force like a "battering ram" and destroy him.

Centralization was critical to the realization of methodical battle. Initiative and innovation were both unnecessary and discouraged. Timing and synchronization were everything, and such detailed battle rhythm could be thrown off if subordinates acted independently. From the watchful eye of the command post, the commander could achieve a near-omniscient view of the battlefield, make calm, rational decisions, and communicate them instantaneously to subordinates who would follow them precisely. Methodical battle was the manifestation, *par excellence*, of linearity in war based on rational calculation.[31]

The French 55th Division commanded by General Lafontaine defended the Meuse River at Sedan against Guderian's Panzer Corps. Prior to the war, the Division became an *ad hoc* agglomeration of units cobbled together from separate battalions and separate companies within battalions due to the nature of the French training and organizational systems. For the French such *ad hoc* arrangements were acceptable. Units were interchangeable; like units carried like combat power. As a result, the division, while strong on paper, and while strong in the eyes of the French chain of command at the time, summarily lacked the training, discipline, and cohesion necessary to fight effectively against the dynamic onslaught of Guderian's more agile battalions.[32]

The French frontline soldiers fought well enough to win. Of the six crossing sites Guderian wanted over the Meuse, only three were established by the end of the first day. By nightfall, the Germans had only a handful of infantry across the Meuse working their way toward the heights south of Sedan. Not a single tank would cross until 0600 the next morning.

To the French division commander, the situation must have seemed quite manageable. Although there were some reports of penetration, the division remained intact along the front. He had an armored and a motorized battalion as the division reserve and 174 tubes of artillery to support the defense. The French X Corps had also allocated two infantry regiments and two tank battalions to the 55th Division. By strict correlation of forces calculations, the French had a decided advantage.

Nonetheless, reality on the ground differed significantly from what was displayed on the map. The German attack began at 1500. A few hours later, the moral factors of the division had collapsed, and the rout was underway along significant portions of the

front. Lafontaine, secluded in his command bunker miles away from the front, had little idea of the psychological collapse of his soldiers. Around 1800 the command post had sent an officer forward to gather some information. He returned shortly afterward with alarming news: a mass of soldiers was fleeing along the road by the command post.

Most of the soldiers were from artillery units located a few kilometers forward of the command post. Nevertheless, there were infantrymen and engineers intermingled with the artillery. Given the distance they had to travel from the front, panic must have begun almost immediately among the infantry.[33]

One artillery battalion commander insisted he had been given the order to withdraw and was moving in convoy with his vehicles and cannon; others were fleeing without weapons. The division chief of staff, Colonel Chaligne, explained, "All the panicked men said that the enemy was in Bulson [2 kilometers forward of the bunker] with tanks and that he would break out at any moment."[34] Panic was infectious, spreading like wildfire in parts of the division, particularly in the artillery. The aerial bombardments of the morning and afternoon had an unsettling effect psychologically, even though the physical damage was minimal. The psychological imbalance, when coupled by the sight of soldiers fleeing with German tanks supposedly on their heels, was all that was necessary to create massive disequilibrium. Inaccurate reports of German tanks, miscommunication, and combat stress imploded the moral factors of significant parts of the division in the first few critical hours of the fight.

Lafontaine and his staff attempted to stop the fleeing soldiers by placing trucks across the road and ordering the soldiers at gunpoint to halt and reform into units. When the Germans had not appeared near the command post by 1900, Lafontaine surmised the

reports had been false, but the damage had nevertheless been done. Panic continued in the division, although it had slowed near the command post. The remaining, increasingly isolated and panicky defenders were left to fight with significant numbers of artillery pieces undamaged but unmanned and thus out of the fight.[35] Instead of 174 tubes, they had almost none.

By 1900 the French Xth Corps and 55th Division had enough of a grip on the situation to make the decision to counterattack the German penetrations. Lafontaine had decided to move his command post to a private house in a nearby town. The soldiers at the headquarters, however, thought the move was due to the impending arrival of Germans and so started burning documents and secret codes. A nervous switchboard operator destroyed the central switchboard for the division. In what Allison and Zelikow would label as classic Model II bureaucratic output, the panicky soldiers in the command post, following their standard procedures for command post evacuation, summarily destroyed most of their ability to communicate securely with the division and Corps.[36]

Nonetheless, with Corps reinforcements, Lafontaine had nearly three infantry regiments and two tank battalions for the counterattacks – more than twice the forces the Germans had across the river. The force was sizeable on paper but had whittled significantly due to frictions. The four infantry battalions under the immediate control of the 55th Division were reduced in actual size to about half that number. Some elements were detached for taskings, some had suffered attrition from previous engagements, others had been consumed by panic and fled. The viable elements of the reserve forces had begun counterattacking that night and reestablished a shaky line in front of the Germans after midnight.

The Xth Corps had given Lafontaine two infantry regiments and two tank battalions on the evening of the 13th that were to be employed in a counterattack early on the 14th. Various frictions in communication and movement of vehicles added to the frustration of LaFontaine and the commanders of the reserve units. Nonetheless, by 0645 the 213th Infantry Regiment supported by the 7th Tank Battalion was prepared to counterattack along three axes to blunt the German infantry. The commander of the counterattack, however, was not enthusiastic about his own prospects: "This is a mission of sacrifice that you ask of my Regiment."[37] The counterattack was conducted without vigor and without coordination between the infantry and tanks. The attack was quickly repulsed by the German infantry supported now by tanks that had crossed the river that morning.

Meanwhile, the 205th Infantry Regiment and 4th Tank Battalion had arrived that morning and were ordered to follow the attack of the 213th Regiment. By 0945 the 205th encountered soldiers from the 213th fleeing rearward. After short but intense contact with the Germans, the 205th Infantry and the tanks supporting them turned and withdrew at full speed. The withdrawal became a rout. The two infantry regiments and two tank battalions, although they did suffer attrition due to German fire, were combat ineffective due to psychological collapse. By 1330 on 14 May, less than one day after the attack across the Meuse had begun, the assessment by the 55th's chief of staff was that the "Division no longer existed."[38]

The battle illustrates nonlinearity. By strict correlation of forces calculations, the French division should have been able to stop Guderian's corps at the Meuse. The physical strength on the ground early in the fight on 13 May, however, was deceiving.

Physical representations of the situation masked reality, providing an illusion of certainty amidst the disequilibrium resulting from psychological implosion in the ranks. The French leaders, detached from the soldiers on the ground, recognized the psychological collapse too late and were powerless to stop it. Nonetheless, some of the French infantry fought well enough to stop the Germans at the Meuse. However, as growing numbers of friendly forces panicked, the remaining French defenders were increasingly isolated and either panicked themselves or were enveloped from behind as huge gaps developed in the French lines. In just three hours what was once a strong defense on paper had become an atomized frenzy of panic. Psychologically, the division had ceased to exist by roughly 1800. It was only a matter of time before the physical reality caught up.

General Lafontaine made plenty of good and timely decisions in his counterattacks with the division reserves and those allocated by Xth Corps. His decisions, however, failed to translate into effective action on the ground. Although the Germans had only the equivalent of five battalions across the Meuse by late-morning of the 14th, the French were unable to halt the advance despite mathematically having the forces to do so. The division and its reinforcements had collapsed completely. The French commander was not "out-OODA-looped" in the classic sense. His decisions were by no means inappropriate. He had not suffered from paralysis or shock to a degree to which he could no longer make decisions. The pendulum of the 55th Division swung wildly out of control because of psychological imbalance more than any other factor. Self-defeating behavior on the parts of soldiers and leaders soon followed until the division no longer existed.

Meanwhile, despite setbacks on three of the six crossing sites and stubborn French resistance on many parts of the front, the German leaders, well forward in the action, sustained the will of the soldiers. What would have been fantasy following the strictures of linear logic became realities due to nonlinearity of war. The fight defied proportionality and additivity due to the human factors of war.

Concluding Thoughts

War is an inherently nonlinear phenomenon. It can be unpredictable by analytical means. Moral factors, the collisions of opposing wills, decisions, capabilities, and psychodynamics, are intrinsic to real war and on any given engagement can generate results that defy the odds. Nonlinear outcomes generate unexpected new realities that are not immediately discernable, particularly when the problems of bounded rationality weigh in the balance. Leaders often see what they want to see until the situation alters beyond a threshold of belief – until evidence that the perception of reality is wrong becomes overwhelming. At that point, however, the opportunity for exploitation of an enemy imbalance or the opportunity to restore equilibrium might have passed. The presence of nonlinear outcomes in war suggests the intractability of potential, intrinsic, predictive, and dynamic uncertainties. Even if simple uncertainties are reduced and commanders have a good grasp of the physical realities of the battlefield, decisions, actions, and outcomes can defy predictability.

Chapter Eight

Interaction and Adaptive Complexity in War

Chapter Seven focused on uncertainties that result from nonlinearity. This chapter expands the uncertainties that result from interaction by exploring the concept of adaptive complexity. We begin with a brief description of complexity. The concept is then leavened by theories from the fields of economics, evolutionary biology, and nonlinear science. Finally, we examine some historical examples to illustrate how adaptive complexity can manifest itself in war. Adaptive complexity serves as the theoretical nexus for understanding war. It synthesizes the human, nonlinear, and interactive dimensions of war into a coherent construct.

In the previous chapter we explored briefly the concept of adaptation. As we have seen, the moral factors of war can create outcomes that defy proportionality and additivity. The resilience of the combatant shapes its ability to cope with interaction. Disparities in moral factors between combatants can determine whether the interaction will generate a linear or a nonlinear outcome. As we have seen, nonlinear responses are quite evident in war. They can be dysfunctional or functional in nature. They generate unpredictability because they defy linear logic. Particularly when a significant disparity exists in the moral factors of the two combatants, outcomes can defy the odds.

Still, not all combat actions are nonlinear or completely unpredictable. In engagements between forces of roughly equivalent moral and material factors, linear outcomes are quite likely.[1] The side with the strongest battalions, to paraphrase

Napoleon, often wins. At the same time, it is possible to arrive at general predictions about outcomes between combatants in which the moral factors are decidedly in favor of one side. By the initiation of the ground campaign in Desert Storm, for instance, commanders were reasonably very confident that the conscript Iraqi forces would not withstand the onslaught of the US-led coalition armies. While the magnitude of the disparity defied prediction, the outcome in terms of whether the coalition forces would extricate the Iraqi Forces from Kuwait was held in little doubt. The engagements between US forces and Republican Guard forces, by contrast, were more uncertain because of the perceived state of the latter's moral factors. Those battles defied prediction as well. The results, as we will see later in the chapter, had interesting consequences, particularly regarding war termination.

Nonetheless, interactions multiply over time. Interactions occur at all levels continuously as the war progresses, so the possible outcomes expand geometrically. Often, the interactions produce results that were completely unanticipated due to human factors and the existence of nonlinearity. Complexity results when individuals and organizations attempt to adapt to the interactions and impose their will on one another.

Complexity

A straightforward way to appreciate complexity is by contrasting it with simple and compound systems. A simple system is linear: the force of a single input will elicit a proportional and predictable output. Decision-making in simplicity is fairly easy because the combatant is responding only to a single input. For instance, the presence of a

bomber overhead that is targeting a ground unit will elicit a predictable "scatter" response. To escape the effects of the bomber, the ground unit disperses. It is a simple problem. A compound system is one in which two or more inputs are present that force a combatant to make choices; often the choice to avoid one input will increase vulnerability to another. This time, the ground unit is facing both a bomber and an opposing ground force. The best reaction to the bomber is dispersion, but the choice will make it more vulnerable to the opposing ground force. Conversely, the best choice to oppose the ground force is to concentrate the friendly ground forces. Doing so, however, makes the friendly ground force more vulnerable to the bomber. The commander is essentially on the "horns of a dilemma."

War, however, is not an isolated act. Outcomes have effects, or consequences, that alter the general situation and impact the choices of others. War is also conducted for some political purpose. The outcomes of engagements and campaigns affect the choices, the options available to meet them, and might even shape the political goals and objectives of the war. A compound system has interaction on a single level – the friendly and enemy force. A complex system is one in which interactions take place on multiple levels at once: self, friendly forces, enemy forces, and the external environment in its totality. Furthermore, those interactions have consequences that shape the nature of future interactions. The interactions have continued orders of effects as the war unfolds.[2]

The combination of linear and nonlinear outcomes in war, when coupled with the human influences and discontinuities in OODA cycles, creates complexity. As each side interacts with itself, its friendly forces, the enemy, and the external environment, the number of possible outcomes increases geometrically to the number of meaningful

inputs.[3] As each side adapts to the meaningful inputs, the resulting interactions can generate outcomes that seemed unlikely from the perspective of the combatants as they looked forward in time.[4] Looking backward from the outcome, however, one can often readily see how the interactions unfolded in a logical, understandable manner.[5]

The Owl of Minerva, wrote Hegel, flies only at dusk. We are wise in hindsight. Knowing the outcome we can understand the process that led there. From the perspective of the one looking forward, however, the result is often but one of many possible outcomes foreseen or not by the observer. From the perspective of hindsight information contains meanings different than the same information viewed from foresight. Adaptive complexity in war makes the future uncertain. Theories from the fields of economics, evolutionary biology, and science can help develop the notion of adaptive complexity in war and the uncertainties that result from it.

Extended Market Order Theory of Dispersed Information

In Chapters Four and Five we discussed how individuals and organizations perceive, process, and interpret information and make decisions based on their cognitive maps and perceptual lenses. In Chapter Six we analyzed discontinuities in how individuals and organizations translate decisions into actions. The process is influenced in many ways by the unique manner in which individuals navigate the cognitive hierarchy from data to information to knowledge to understanding. The "extended market order" conceptualized by economist Friedrich von Hayek (1900-1992) lends further insight into how individuals and organizations function in and create complexity.

Hayek viewed the market as an evolutionary process of discovery and adaptation in which individuals gathered, processed, and interpreted information and made choices. What appears chaotic is, in fact, the "spontaneous order" of the market that is beyond any centrally designing intelligence.[6] "Modern economics explains how such an extended order can come into being," suggests Hayek, "and how it constitutes an information-gathering process, able to call up, and put to use, widely dispersed information that no central planning agency, let alone any individual, could know as a whole, possess, or control."[7]

Hayek argues that information, knowledge, and understanding are "essentially dispersed" in space and time. Navigation up the cognitive hierarchy is as complex as navigation of our own cognitive maps. Understanding is not a single destination; it is contextualized in time and space and by our own cognitive maps and perceptual lenses. Thus, specific information, tacit knowledge, and understanding can come into existence and manifest themselves in ways peculiar and specific to context.

> Much of the particular information which any individual possesses can be used only to the extent to which he himself can use it in his own decisions. Nobody can communicate to another all he knows, because much of the information he can make use of he himself will elicit only in the process of making plans for action. Such information will be evoked as he works upon the particular task he has undertaken in the conditions in which he finds himself... Only thus can the individual find out what to look for, and what helps him to do this in the market is the responses others make to what they find in their own environments... The market is the only known method of providing information enabling individuals to judge comparative advantages of different uses of resources of which they have immediate knowledge and through whose use, whether they so intend or not, they serve the needs of distant unknown individuals. This dispersed knowledge is essentially dispersed, and cannot possibly be gathered together and conveyed to an authority charged with the task of deliberately creating order.[8]

The meaning of information is in the eye of the beholder. Explicit knowledge, meaningful information that can be entered into data-bases and information systems, differs from tacit knowledge, which is implicit information and processing capabilities that individuals carry inside of them as a result of their cognitive maps and perceptual lenses.[9] Tacit knowledge is drawn upon only in particular circumstances. It shapes the manner in which we behold information, and in how we create knowledge and understanding and the degree to which each is relevant and appropriate to the situation. The fusion of explicit information onto a situational awareness screen, therefore, does not by any means automatically result in homogeneity in interpretation and decision.[10]

The path to understanding and making decisions is unique to the context of the individual in the situation. Although some parts of the situation can be anticipated, the context in totality is impossible to replicate in advance. Sometimes the unanticipated factors are not enough to undermine the preconceived decision or analytical framework. Other times seemingly subtle changes in conditions can alter fundamentally the perspective of the observer. Moreover, other elements of information can only be known later in time and space because of the nature of interaction. Other people make choices that affect the options available to us and the choices we make. A surprise attack, for instance, can be called off at the last minute if the target, our own forces, or external forces have acted in a way that would compromise the viability of the attack.

Lyle Bouck's decision to stand and fight on 16 December 1944 against the initial recommendation of his own soldiers was a product of the uncertain context and the powerful effect the order to "hold at all costs" had on him.[11] The decision by the regimental staff to have Bouck "hold at all costs" was likewise a product of the context.

Asking a platoon to defend in place against odds ranging between nine and twenty-seven to one is patently suicidal. The combination of staff output (Allison and Zelikow's Model II) as they tried to make sense of the situation and maintain equilibrium and Bouck's stubborn insistence on obeying orders in the particular context of December 16, 1944, made the critical fight at Lanzerath possible.

Similarly, in May 1940 the same information shared by the German High Command all the way down to Guderian's Panzer corps that the French were counterattacking in the Sedan area of operations elicited fundamentally different responses. The High Command, Army Group A, Twelfth Army, and von Kleist processed the information and made a decision that Guderian should get his forces across the Meuse, orient south, and defeat the French counterattacks. Guderian saw the same information and decided to disobey those orders and continue the attack west with most of his corps.

The dispersal of information and understanding reached even lower. Guderian apparently intended to strike west with only one division, while leaving the bulk of his forces (2 Panzer divisions and an infantry regiment) to defend the bridgehead. It was the recommendation of his subordinates in the 1st Panzer Division that convinced him to put two divisions in the attack instead.[12] The "tacit" knowledge, essentially dispersed among observers adapting to their context in time and space, had a decided influence in the outcomes of the above battles and also created subsequent orders of effects that shaped the outcomes of the campaigns.[13]

Theories of Evolutionary Biology and Adaptive Complexity

Essentially dispersed information plays a critical role in understanding the relevance of evolutionary biology to war's adaptive complexity. According to the theory of evolutionary biology, the earliest point at which a new species can be discerned is called a speciation event. The mitochondria in the cells of the species are the fingerprint from which one can determine commonality. In the human species, the female line is the one that passes along the mitochondria. All of the people alive today are, theoretically, the offspring of the "Mitochondrial Eve" – the most recent direct ancestor of every human being alive today.[14]

Her status as the "Mitochondrial Eve" is dependent upon contingencies in her own times as well as circumstances in later ones. Future contingencies are shaped by the initial choices and actions of the "Mitochondrial Eve," but are not determined by them. Subsequent outcomes are also shaped by choices and actions through the passage of time. In hindsight we can, in theory, trace a logical sequence of decisions, actions, and outcomes, all the way back to her. Such reconstruction in hindsight, in fact, would result in a logical chain of events that would seem obvious at each point along the way. From the perspective of foresight, however, today's "Mitochondrial Eve" was but one candidate of many over the expanse of time and humanity, impossible to select in advance. Indeed, the actual "Mitochondrial Eve" might appear to be the least obvious among the different possible candidates. The complexity and subtleties of interaction and adaptation make outcomes over time increasingly unpredictable.

Darwin's central thesis of evolution is that the rich diversity of species come about "chiefly through the natural selection of numerous successive, slight, favorable variations; aided in an important manner by the inherited effects of the use and disuse of parts; and in an unimportant manner, that is in relation to adaptive structures, whether past or present, by the direct action of external conditions, and by variations which seem to us in our ignorance to arise spontaneously."[15] Darwin's theory of natural selections is not without its flaws, but as one observer notes, the core thesis is the only empirical theory that is capable "of solving that most difficult of problems posed by life anywhere in the universe, namely, the problem of the existence of adaptive complexity."[16]

At the risk of oversimplifying complex theory, it is useful to take a relatively simple analogy to describe the process. The giraffe we know today as a long-necked herbivore that dines on grass and leaves might look markedly different than its ancestor, which we will label "proto-giraffe." As we trace back from current giraffe to proto-giraffe, we can begin to determine the effects of diet, other creatures, and the external environment. We can also examine particular characteristics that enabled some proto-giraffe to survive while others without those characteristics died off. Over the expanse of time, the elongation of the neck became crucial for the survival of the species because of its unique ability to access food at heights of trees.[17] Other options may have been available to proto-giraffe over the courses of interaction and adaptation, such as diet conversion to carnivore, or the development of other parts for protection or self-defense. There may have even been species of giraffe that evolved along those lines. For many reasons, the giraffe we know today is the one that survived. Looking backward, the process by which today's giraffe came about would seem quite logical. From the

perspective of proto-giraffe, it was merely one of many possible outcomes. Events within and external to the control of giraffes over time shaped the way the species looks today.[18]

Complexity in Nonlinear Dynamics

Complexity theory in nonlinear dynamics lends further insight into the interaction and adaptation processes. The term "bifurcation" in nonlinear theory refers to the capacity of a system to exhibit multiple stable states. At certain points, in certain conditions, the system has two states available to it.

> For one range of perturbations and conditions, the system will settle down to one state and for another range of perturbations, it will settle down to another state. As we progress ... each branch splits, and then each branch further splits resulting in the rapid increase in the number of stable states.... Chaotic systems appear to have an infinite number of potentially stable states. But they never settle down to any of these for long and are therefore considered unstable.[19]

"Attractors" are points of stability the nonlinear, bifurcating system move toward over time. An attractor can be something in real life that draws our attention. One scholar analyzes the American raid in Mogadishu, Somalia, to capture members of the warlord Aideed's clan as an example of a bifurcating system. The "state" of the residents of Mogadishu was "perturbed" by the presence of US soldiers in the town conducting the raid. Some people remained going about their daily lives, others began to erect barriers and ignite signal fires. As the raid progressed and as Somalis continued to fire upon US soldiers, residents increasingly abandoned daily life and moved to the scenes of action. As US forces fired into crowds of armed and unarmed people, the crowds increasingly became mobs that actively helped the Somali gunmen rather than remaining as curious

observers. Bifurcations continued with adaptations to the rapidly changing situation. Gunmen hid behind women and used children to point out targets for them; Americans brought in more helicopters and soldiers to extract those trapped on the ground. The increased presence of helicopters brought RPG gunners to the rooftops. The shooting down of a helicopter became another "attractor" as Somalis flocked to the scene of the action and Americans desperately tried to get there as well to recover the pilots and crew. The crowds and US forces oscillated back and forth between attractors: various scenes of action and areas of cover. As the number of attractors increased, so did the number of bifurcations and possible "states."[20]

The term bifurcation, however, seems to overly simplify the complexity. The range of choices in many situations encompasses more than two. Perhaps the term "polyfurcation" better expresses the myriad options and outcomes often present in war. For instance, Somali citizens at the outbreak of hostilities had choices to continue going about their daily lives, to watch from a distance, to throng at the scenes of action, or to participate actively against the Americans. Moreover, these choices were not irreversible. Individuals over the course of the day could, and did, oscillate between those actions. We could be reasonably sure that particular scenes of action or dramatic events would draw crowds. The shape and intent of those crowds were not as predictable. The powerful effect of attractors does suggest that management of them could enable a commander to exert some influence over crowds.

The theories of the extended market order and the criticality of essentially dispersed tacit knowledge, when combined with adaptive complexity seen through the

concepts of evolutionary biology and nonlinear dynamics, suggest that how battles, campaigns, and wars unfold can be highly contingent. Unpredictable human factors coupled with the interactive and iterative processes of war make outcomes uncertain.

Even situations in which a striking military imbalance exists, the general outcome of the war can remain quite unpredictable. The challenges in war termination experienced by US-led coalition forces in 1991 created an outcome in which many Iraqi Republican Guard Forces remained intact and the Iraqi leadership was allowed to fly helicopters at will. Despite the overwhelming nature of the military victory in the Gulf War, the Iraqi government gained an unexpected windfall that enabled it to suppress post-war revolutions by the Kurdish and Shi'ite opposition forces in northern and southern Iraq.[21] Likewise, the overwhelming victory of US and Northern Alliance forces over the Taliban regime and the Al-Qaeda network in Afghanistan during Operation Enduring Freedom has by no means led to certainty regarding the viability of the interim Afghan government or to peace and stability among the fragile factions within the country. The complexity of human adaptive interaction generates outcomes that are very difficult to foresee, even in situations of complete military dominance. Situations of less imbalance or parity can exacerbate the dynamic and predictive uncertainties.

The Doolittle Raid, April 1942

The Doolittle Raid on Japan during the Second World War illustrates the uncertainties generated by complexity. On 18 April 1942, Lieutenant Colonel James H. Doolittle led a raid on Tokyo with sixteen B-25 bombers launched from the aircraft carrier *Hornet*. The purpose of the raid was simply to lift American morale by attacking

the "sacred home soil" of Japan.[22] In the event, fifteen planes dropped bombs on the Japanese home islands, and some also strafed ground targets. The direct damage inflicted by the raid was negligible at the grand scale: 12 people dead, 50 houses and shops destroyed, and the bow of a warship damaged in dry-dock.[23] The direct military effects were inconsequential. In terms of direct effects on the Japanese economy and war production capabilities, the cost of the raid far exceeded its benefits. Edwin Layton, an intelligence officer from December 1940 to the end of the war, concluded that "the effects of the raid were not momentous, nor commensurate with the American risk of two of our four precious aircraft carriers in the Pacific."[24]

The raid did, however, have interesting and important subsequent order effects that illustrate the complexity of war. The psychological effects on the American people were helpful in the aftermath of Pearl Harbor. Headlines from newspapers in America celebrated the strike on Japan, while those in Japan expressed outrage over the killing of children when a US bomb inadvertently hit a schoolhouse. The psychological effect on the Japanese military was the most pronounced. The "loss of face" in failing to protect the home islands led to decisions by the Japanese military that would have important consequences.

The Japanese military diverted 53 battalions to execute a punitive expedition in the Chekiang province where Doolittle's planes landed. They also brought home four army fighter groups to defend the home islands. These remained in Japan through 1943 until they were redeployed to meet urgent needs in the Solomons. During this period there were no other US raids on Japan. Thus, critical military resources were diverted on

punitive expeditions and home island defense that were in hindsight needed, and more useful, elsewhere.

The effects on Japanese strategy were even more pronounced. The Japanese naval staff, mortified by the attacks on the home islands, committed themselves to courses of action that were, in the end, self-defeating. First, opposition to Yamamoto's plan to attack Midway Island dissipated rapidly in the wake of the Doolittle Raid. Pushing the envelope of protection outward in the Pacific to prevent future raids was seen as a prudent strategy. So prudent in fact that the Japanese high command also sanctioned a concurrent thrust toward Australia (Fiji/New Caledonia). The result was that the Japanese were unable to concentrate critical forces for either attack. Both ultimately ended in critical 1942 reverses for Japan in the Battles of Coral Sea (5-8 May) and Midway (3-5 June). The battle of the Coral Sea, even though the loss of the carrier *Lexington* in exchange for the light carrier *Shoho* favored the Japanese, forced the Japanese to cancel their plans to invade Port Moresby. The outcome, with damage to an additional Japanese carrier and the significant loss of aircraft from another one, reduced Yamamoto's carrier strike force at Midway by a third. To be sure, the additional forces there might have had significant consequences on how the Pacific war unfolded.

In the 1970s the Japanese Defense Agency's official history of the war concluded that the Doolittle Raid had the following effects: 1) it caused morale problems in Japan; 2) it caused the Japanese military to lose face because they said the home islands could *never* be bombed; 3) it caused critical diversions of combat power, particularly the four fighter groups; 4) it resulted in the Japanese Army's support for the Midway operation (they had heretofore been opposed); 5) the Imperial High Command supported the

Midway-Aleutian Islands campaign unreservedly (the Aleutian component was a further erosion of Japanese strength at Midway).[25]

The importance of the Doolittle Raid, therefore, was not in the direct military effects, but on the impact it had in the psychological and cognitive domains. The raid helped to set in motion a chain of events that had significant consequences on the Pacific War. In an important way it induced strategic blunders on the part of the Japanese, leading to self-defeating diversions of resources and energies.

At the same time, the effects of the Doolittle Raid belong to the singular context of April 1942. Attempts to find some sort of strategic silver bullet from the raid as a recipe for future war are highly problematical. The effects were contingent on activities and impressions that occurred before the raid – the proclamation of invulnerability of the home islands, personal and cultural aversion to loss of face, the ability to land aircraft in China due to the presence of viable opposition forces, as well as existing but at the time conflicted Japanese plans to establish a buffer zone in the Pacific against the United States. They were also contingent on decisions and actions subsequent to the raid that were shaped by the raid's effects but were not necessarily made inevitable by them.

The Combined Bomber Offensive

The Combined Bomber Offensive (CBO) in the European Theater also generated orders of effects that had importance beyond direct military outcomes. The effectiveness of the CBO has been hotly debated among scholars of war. The Army Air Forces official history of the campaign argues that the "Reich was strangled and paralyzed. Even without the final ground invasion, it seemed, the Germans could not have continued the

war."[26] The head of the US Strategic Bombing Survey (USSBS), economist Kenneth Galbraith, however, saw the issue much differently. Based on the fact that German production of tanks and aircraft increased dramatically during the period from 1942 to early 1945, Galbraith considered that the campaign was an overall failure, and perhaps even "the greatest miscalculation of the war" in terms of direct impact on the German armaments production.[27] At most, he commented, "[I]t eased the task of the ground troops [but]... [t]he aircraft, manpower, and bombs used in the campaign had cost the American economy for more in output than they had cost Germany."[28] A historian of the air war, meanwhile, argues simply, "The only conclusion that the evidence bears is the more negative conclusion that victory for either side could not have been gained without the exercise of airpower."[29] The evidence, in terms of tank and aircraft production, certainly suggests that the direct military effects of the Combined Bomber Offensive were disproportionately low.

From the perspective of adaptive complexity, however, the picture is much different. Due to the devastation of the raids on the German people and cities, Hitler could not stand idly by and create the impression he was doing nothing to defend against the attacks. While the German aircraft were the most effective air defense weapon, fighter aircraft did not have the same cathartic effect on the people as the 88mm anti-aircraft guns that ultimately ringed German cities and blasted exploding projectiles into the air. In fact, the odds of an 88mm gun destroying an airplane were 16000:1.[30] For psychological reasons, the 88mm cannon was the weapon of choice against the CBO. In fact, air defense munitions accounted for fully one-third of total German munitions production by June 1944.[31]

The 88mm guns were far more effective as anti-tank weapons. The employment of the 10,000 or so cannons that ringed German cities by 1943 and 1944 could have had significant effects on the ground in the eastern and western fronts. Visually spectacular but relatively useless as defense against the CBO, the deadly 88mm cannon was far less effective for the Germans than it could have been.

Another strategic blunder by the German High Command due to the CBO was the diversion of resources to V-weapon production. The German people demanded reprisals for the attacks on German cities, so resources went to bombers and V-weapon production. The choice to invest huge amounts of resources in "revenge" weapons (the V stands for revenge in German) inhibited the development of an effective anti-aircraft rocket and diverted resources from fighter aircraft production, to include jet aircraft.[32]

The sub-optimal output of aircraft had further effects on the war. Particularly after the US employed the P-51 Mustang as long-range fighter escort, attempts by the German Luftwaffe to defend against bombing raids broke the back of German air power by 1944. The results were critical: the daylight bombing was able to continue without significant Luftwaffe interference, and the allies had complete air superiority in support of the Normandy landings.[33]

The raids on German oil facilities were similarly critical. The contraction of petroleum, oil, and lubricant (POL) products limited the number of available flying hours for German aircraft and also restricted the options of German ground commanders. The 1,800 tanks that were present to defend Silesia, for instance, were virtually immobilized in January 1945 for lack of fuel. Similarly, the Ardennes offensive in December 1944

was initiated with the understanding that the Panzer armies lacked the fuel to accomplish their mission. The Germans relied on capturing Allied fuel dumps.

Unquestionably, the CBO affected the conduct of the ground war on many different levels. As one historian suggests, "Victory over Germany is inconceivable without the Combined Bomber Offensive, just as victory is inconceivable without the victory of the Allied navies in the Battle of the Atlantic, or the contribution of the Red Army on the Eastern Front, or the Mediterranean theater and the great invasion of Western Europe in spring 1944."[34] The particular effects of the CBO, like those of the Doolittle Raid, belong to the singular time and place of the European Theater of Operations in World War Two.

Certainly the context of Nazi Germany and the context of the war shaped the decision for CBO and how it was implemented. The need to open a "second front," even an aerial one in Europe, was crucial to keep pressure off of Britain and to keep the Soviets in the war. The nature of the Nazi regime and Hitler's own "baggage" from the First World War in which the "stab in the back legend" of a disgruntled populace held currency certainly played a large role in ensuring a very visual display of air defense in and around German cities, even if the effect was illusory and ultimately counterproductive. The chaotic nature of Nazi bureaucratic politics and the confused procurement system also played critical roles in retarding the war production effort and contributed mightily to the pathological penchant for poor production decision-making in the Nazi hierarchy.

The Combined Bomber Offensive promoted interactions at multiple levels. The polyfurcations created myriad potential outcomes for the war. When combined with

other fronts and activities, the CBO shaped the war in important ways. The effectiveness of the CBO, to be sure, was determined by the subsequent German responses, but the CBO by itself did not determine those responses. It added important interactions, increased the complexity, and set the conditions for the self-defeating decisions and strategic blunders by the Germans.

The effects of the air campaign were radically different than those prophesied by air power enthusiasts such as Douhet and Mitchell before the war. Nonetheless, the CBO had an important effect on how the war unfolded and ended, shaping it but not determining it.

Ardennes 1944

Similarly, the aforementioned stand by the I&R platoon at the outset of the Battle of the Bulge initiated a chain of events that resulted in American engineers being able to blow bridges literally in the face of Peiper's Panzers and eventually halt his advance. A small force that should have been overrun with ease according to mathematical analysis, held its position for nearly eight critical hours, buying crucial time for American counteractions. The small "input" by Bouck's platoon had a disproportionately large effect on the outcome of the Ardennes Counteroffensive.

Bouck and his men were held captive in a café in Lanzerath where the German regimental commander established his headquarters. Later that evening, an angry German Panzer commander, Joachim Peiper, entered the café demanding to know why the parachute regiment remained in Lanzerath and had not continued to advance to a critical crossroads several miles further. The lack of progress was delaying the German

main attack. The regimental commander replied that the woods were held in at least battalion strength, fortified with concrete pillboxes and a dense network of minefields.[35] The reality on the ground was that nothing stood between the German regiment and its objective, as Peiper discovered when he decided to attack the mythical American battalion the next morning. Nevertheless, Bouck's platoon stopped the advance of *Kampfgruppe Peiper* for several critical hours.[36] The fight bought time for the Americans to regroup, for engineers to blow critical bridges in Peiper's path literally minutes before his tanks arrived at them, and thus set in motion a chain of events that would end with Peiper being bottled up between blown bridges near the Belgian town of La Gleize, and eventually defeated.

The Gulf War

The Gulf War is a modern example of war's complexity and uncertainty in a situation of significant military disparity. The original plan for the US-led coalition ground campaign entailed an attack by the Marines into Kuwait, followed twenty-four hours later by the "left hook" of the enveloping VII and XVIII US Corps. The US Central Command planners had assumed that the Marine attack into Kuwait would result in an Iraqi counterattack by the Republican Guards. As the Republican Guards counterattacked into Kuwait, they would actually be drawing themselves further into the Coalition trap. The two corps would envelop and destroy the Iraqi Republican Guards in seven to ten days.

Based on the fight at Khafji in January 1991 and activity with Iraqi frontline units on the Kuwaiti border, the Marines revised their estimate. They now believed they could

reach Kuwait City in as few as three days. The timing of the left hook, however, was not revised to reflect the anticipated increase in tempo.[37]

As early as 0840 on 24 February, just over four hours into the ground war, General H. Norman Schwarzkopf, began receiving reports of Iraqi demolitions in Kuwait City. These activities indicated that the Iraqis were beginning to withdraw. Still, the two Corps could adjust the timing of their attack only eleven hours forward. Coalition forces were already losing valuable time in the race to envelop the Republican Guards due to the Iraqis' unexpectedly early decision to withdraw. To exacerbate the problem, the VII US Corps Commander, Lieutenant General Frederick Franks, stopped the advance of his forces as darkness approached on the first day with the intent of resuming at daybreak. Although the decision was made for many good reasons, it added to the timing problems for the Coalition.

Nevertheless, had the Iraqis cooperated and launched the assumed counterattack against the Marines, the envelopment still would have been viable. As the interactions began to unfold at each level, however, the Iraqis made the decision to withdraw rather than counterattack. They began large-scale movement of vehicles from Kuwait the night of 25/26 February.[38] The unexpectedly swift advance by the Marines, rather than serving as "attractors" for the Republican Guards, most likely increased the pace of the withdrawal. Much like Napoleon in Russia, the harder the coalition forces pressed in Kuwait, the quicker the enemy forces retreated.

In addition, the Corps making the deepest envelopment, the US XVIII Corps, made a crucial change in plan prior to beginning the ground offensive. Initially, the US 24th Infantry Division (Mechanized), commanded by Major General Barry McCaffrey,

was to be positioned on the left flank of the Corps. As the left-most element, the division would make the deepest penetration into Iraq. It could avoid Iraqi forces, seize the critical crossroads at Safwan, and cut off the Iraqi withdrawal.

The original line of advance would take the 24th Division through some Shi'ite towns. Fearing that Iraqi women and children would try to impede McCaffrey's tanks, the Corps decided to reposition the division to the Corps' right flank to avoid the towns. What the Corps failed to appreciate, however, was the deep hatred of the Shi'ite Muslims for the Iraqi regime and army. Rather than throwing their bodies in front of US tanks, the townspeople would have probably welcomed the sight of Americans. As a result, the more shallow envelopment forced McCaffrey and his division to fight through an Iraqi Corps on the way to "close the gate" at Safwan. The wider envelopment in the original plan might have given the Division a chance to reach Safwan before the Iraqis did.[39]

To make matters worse, miscommunications opened a perceptual gap between Schwarzkopf and US Third Army (the controlling headquarters for the two-Corps attack). While Schwarzkopf believed that his envelopment was going as scheduled, reality on the ground began to indicate quickly that the trap would not be closed. One historian of the war argues that imprecise language between the two headquarters helped to create and sustain the gap in perceptions that persisted until war termination.[40]

As the war continued, graphic scenes from the so-called "Highway of Death" on television, reports of radical imbalance on the ground as US forces annihilated entire Iraqi formations, plus the perception by Schwarzkopf that the "gate had closed" on the remnants of the Republican Guard forces, produced pressure toward halting the ground offensive.[41] Schwarzkopf's perception of reality led him to make the assessment that the

Republican Guards were trapped and to recommend to the US President to stop the war at 100 hours.[42] After issuing the orders to halt the ground offensive, Schwarzkopf was astonished to learn that US forces had not reached Safwan and that Iraqi forces were escaping through the gap there.[43]

According to a Central Intelligence Agency study, by the war's termination, Republican Guard forces retained at least 365 tanks.[44] The Iraqi forces were also allowed, much to their surprise, to retain the use of their helicopters in the "No-Fly Zones." The combination of attack helicopters and Republican Guard forces enabled Saddam Hussein to suppress the internal revolts that had arisen in the aftermath of the war.[45] In October 1994, those same Republican Guard units threatened Kuwait again, forcing the redeployment of sizable US forces to the region.[46] Clearly the Iraqi forces had not been removed as a threat to the peace and stability of the region.

The Gulf War reveals intractable uncertainties even in high-tech wars with superb situational awareness technology and striking military imbalance. Critical frictions and misunderstandings arose due to poor communication between people. They also resulted from gaps between expectations and performance of both Iraqi and US forces.[47] Inaccurate assessments and assumptions about the relationship between Shi'ite Muslims and the Iraqi government resulted in choices that seemed reasonable at the time but proved inappropriate. The unexpected Iraqi decision to withdraw instead of fight added further complexity to the situation and enabled sizable formations to escape the Coalition trap. The example of the Gulf War suggests that adaptive complexity, even in short wars with relatively small amounts of interactions, generates unpredictability. Even good

decision makers with solid processes and relatively good situational awareness can not be completely sure of the outcome.

Operation Enduring Freedom

The conflict in Afghanistan, the most high-technology US war to date, further illustrates the continuing relevance and intractability of uncertainty. Despite a nearly transparent battlefield, the United States was "completely shocked" by the abrupt withdrawal of Taliban and Al-Qaeda forces from Mazar-i-Sharif and other complexes and towns in northern Afghanistan. The US military also did not anticipate that Taliban and Al-Qaeda forces would split after the withdrawal, the former defending in the Kandahar region, the latter in the cave complexes of Tora Bora.[48] The inability of US forces to anticipate such reactions, coupled with lack of robust ground forces in the region, undoubtedly contributed to the Taliban and Al-Qaeda leaders evading capture.[49] Moreover, deliberate deception on the part of rival warlords has led to at least two incidents in which US forces killed friendly Afghans in air and ground raids.[50] The interactions during Operation Enduring Freedom in Afghanistan were arguably even fewer than in the Gulf War, but, despite the dramatic increase in situational awareness technology, the intractable uncertainties remain.

Conclusion

The elder Helmuth von Moltke's aphorism, "no plan survives first contact with the enemy," is an admission of true uncertainty in war. Because interactions occur at multiple levels simultaneously and because of the presence of both linear and nonlinear

outcomes, war is a phenomenon characterized by adaptive complexity. With the benefit of hindsight we can often see how events, decisions, and processes become linked to one another and shape the final outcomes of war. Due to the complexity of interaction, however, predicting the outcome from the position of foresight is difficult at best. "Unexpected military events," one historian notes, "creates a range of possibilities which no sober observer would think to attach a probability to."[51] The outcomes of war, from the position of foresight, are merely one of many possible combinations. Human and nonlinear factors intervene in very interesting ways as the interactions occur at the individual, friendly force, enemy force, and external environment levels. As one scholar points out, "At both the tactical and strategic levels, there is no sure way to narrow the gap between what is expected and hoped for and what actually happens."[52]

Adaptive complexity in war generates paradoxes that defy prediction and the strictures of linear logic.[53] Getting inside the enemy's decision cycle, much less keeping an enemy out of one's own decision cycle, is more than a matter of processing power.[54] The interactive nature of war and its adaptive complexity suggest, in fact, the presence of myriad cycles corresponding to the levels of interaction that affect one another continuously. These complex interactions create and exacerbate uncertainty in war.

Chapter Nine

Coping With and Exploiting Uncertainty

Combatants must possess the capability to cope with their own uncertainty and exploit that of the enemy. Indeed, the combatant who can best cope with and exploit uncertainty has a decided advantage in war. Although coping with and exploiting uncertainty in war is a study in itself, this chapter explores some of the salient issues from a thematic perspective. We begin with observations on the role of information technology and how it fits in the uncertain context of war. Next we explore the themes of equilibrium and balance in terms of coping with and exploiting uncertainty. Within those themes we discuss leaders, organizations, and warfighting concepts.

Information Technology

In Chapter One we analyzed the arguments surrounding the role of information technology in "lifting the fog" of war and curing, or at least reducing the bounds of, uncertainty. The arguments on both sides of the issue were problematic and to a certain extent uninformed due to the lack of intellectual rigor in the understanding of uncertainty. As it turns out, both arguments are sound in some ways and flawed fundamentally in others.

The taxonomy of uncertainty will help illuminate the issue. Information technology can indeed offer a view of the battlefield that is *physically* transparent in many respects. A robust sensor network linked to a global information grid can

illuminate the size and locations of physical forces on the battlefield. It can in many ways reduce the bounds of "simple uncertainty." It can enable one to answer timeless questions such as: Where are the enemy forces? What is their strength? Where are my own forces? Information technology can help commanders and staffs keep track of the physical dynamics of the battlefield. Assuming the picture is accurate (a theme we will discuss shortly), such fidelity, when coupled with precision munitions, can undoubtedly lead to a greater ability to find targets and destroy them with accuracy unmatched in the annals of warfare. Such capability alone suggests that we should pursue vigorously the seamless networking of US forces with the sensor and information grid.

Fidelity of the physical dynamics of the battlespace, when coupled with the ability to communicate rapidly among air, sea, space, and land forces and to bring precision munitions to bear on the enemy, suggests that information technology can lead to an order of magnitude increase in the tempo and lethality of US military operations. During the Gulf War targeting messages and air tasking orders had to be delivered by hand to Navy ships in the Persian Gulf. The flexibility of employing carrier aviation and sea-launched cruise missiles was necessarily limited by antiquated and non-interoperable communications systems among the services. The situation over the skies of Afghanistan in Operation Enduring Freedom is far different. Thanks to improvements in information technology, commanders have been able to "dynamically re-task" aircraft onto alternative objective areas while in flight.[1] Observers on the ground have been able to talk directly to the aircraft and guide them to the new target area.

One such instance occurred at Tarin Kot. After anti-Taliban forces took the town in the first days of Ramadan, the Taliban counterattacked on November 18, 2001, with

approximately 1000 soldiers in roughly 100 pick-up trucks. A Special Operations Forces "A" Team on the ground in Tarin Kot set up an aerial ambush for the oncoming Taliban. Vectoring the aircraft onto the Taliban convoys, the small "A" Team set the conditions for the precision munitions to obliterate the enemy column. In the words of the team leader, "We broke the back of the Taliban that day."[2] Such flexibility is possible because of information technology.

Information technology can also speed the process of communicating orders and information among friendly forces. At the time of this writing, the overwhelming majority of brigade level and below units transmit operations plans and orders the same way Napoleon did two centuries ago: by courier. The needless waste of time can be rectified easily with information technology. Moreover, IT can speed the planning process itself. A war-gaming program, for instance, can help commanders and staffs analyze courses of action and options much more rapidly than is possible using current techniques. Such calculations will be primarily mathematical, but nevertheless they can deliver probabilities that commanders and staffs can use as starting points for estimates.

Simply put, the ability to communicate more rapidly across the battlespace, when coupled with greater awareness of its physical dynamics, can lead to greater flexibility and greater tempo in military operations. The ability to mass precision fires and maneuver forces on a critical area rapidly will increase significantly.

At the same time, it is important to recognize some limits of information technology. War is interactive. Already, military forces across the globe are developing "netwar" and "cyberwar" capabilities to offset American information technology.[3] Technologies – ranging from cybernetic deception to defeat of the sensor-information

grid linkage – will cloud the physical resolution of the battlespace. Adaptation historically renders technology-driven advantages temporary. We have to come to grips with the fact that future adversaries will develop capabilities that will mitigate the current imbalance. We also have to recognize that irrational technological exuberance can have consequences. Excellence in the cognitive and psychological domains of war has offset technological imbalance in the past. The Germans in 1940, for instance, brought superior leadership, organizations, and warfighting concepts with inferior tanks and artillery to defeat the French handily. French technological superiority could not match the synergy of the Germans.

In terms of uncertainty, it is critical to note that while we can reduce the bounds of simple uncertainty, the challenges of predictive, intrinsic, potential, and dynamic uncertainty remain. These uncertainties are part and parcel of the human, nonlinear, and interactive dimensions of war. They are dependent on human physical, cognitive, and psychological states (the moral forces of war), chance, and free will. Understanding these uncertainties and developing leaders, organizations, and warfighting concepts that enable us to cope with and exploit them will be crucial in creating and sustaining a truly effective military force.

Equilibrium and Balance

Resilience and Will

Equilibrium and balance are critical concepts in terms of coping with and exploiting uncertainty. The Clausewitzian notion of war as an object suspended between three magnets expresses the issue simply while preserving depth and complexity. For a

combatant at war, the object is the will, the magnets are the physical, cognitive, and psychological domains. The magnets correspond to the nested "triangle" (military, government, people) and trinity (probability and chance, reason, and passion). Balance and equilibrium in the system imply harmony and stability. The system is robust enough to withstand changes to initial conditions and remain in equilibrium. It is self-correcting.

A system with balance and equilibrium adjusts to meet internal and external impacts. Erosion in the physical domain, for instance, is offset in a robust system by strength in the cognitive and psychological domains. Instead of creating chaos, changes to conditions are coped with, the balance is readjusted, and the system remains in equilibrium.

Each system has limits, depending on its level of resilience. A brittle system in fragile balance, much like the French 55th Division in 1940 or the German parachute battalion at Lanzerath in December 1944, can withstand only minor adjustments. In the former, psychological imbalance generated chaotic behavior in the entire system of the 55th Division despite the fact that the organization retained its physical and cognitive capabilities. In the latter example, physical attrition created chaos in the system in terms of cognitive paralysis and psychological shock, even though the organization retained the physical ability to win. Balance was restored in part of the latter organization when an experienced noncommissioned officer took charge and captured the American platoon, but even that victory was not enough to restore the balance in the German battalion or regiment.

Conversely, resilience can sustain or restore equilibrium to a system under significant pressure. Guderian's Panzer Corps remained in balance despite heavy

casualties and physical exhaustion, particularly in the 1st and 2nd Panzer Divisions and the *Gross Deutschland* Infantry Regiment. The latter, despite heavy attrition, sustained a ferocious defense near the town of Stonne against French counterattacks in order to secure Guderian's left flank.[4] In Bouck's platoon, the psychological desire to withdraw was overcome by strong leadership and sustained by success during the fight. However, once the ammunition ran out, the erosion of physical capability meant they could no longer remain in their foxholes and fight. In terms of maintaining equilibrium and balance, therefore, the level of resilience determines the robustness of the system. Coping with uncertainty requires resilient balance.

Rather than looking at war in terms of order versus chaos, perhaps a more useful contrast would be balance versus chaos. A system in balance is viable, a system in chaos, or disequilibrium, is vulnerable. Sustaining our own equilibrium and creating and exploiting imbalance in the enemy will give us a critical advantage in war.

Creating disequilibrium in the enemy is problematical because the imbalance relies in large part on the nature of the enemy force. An enemy with a fragile equilibrium is certainly vulnerable to effects in the physical, psychological, and cognitive domains. An operation characterized by a high tempo of meaningful effects on those three domains has a good chance of creating chaotic behavior in a fragile enemy. Terms such as panic, shock, paralysis, and dislocation are all manifestations of chaos that lead to the erosion of combatant capability. A more resilient enemy will naturally cope with the effects of our operations longer and more successfully.

War is more than a targeting drill. Arguments that fail to account for the fact that the nature of the enemy has the most critical role in the interplay of balance and chaos are

fundamentally flawed. To be meaningful, any theory of victory or theory of conflict must fully account for the complexity of interaction on all levels. Furthermore, we must recognize that even favorable physical results on the battlefield do not automatically equate to absolutely favorable outcomes in the war. Adaptive complexity in war can confound the most detailed plans and can problematize even the most lopsided battlefield outcomes.

Nonetheless, coping with and exploiting uncertainty requires resilience in the physical, psychological, and cognitive domains of war. The strength of these domains relies heavily on the strength and resilience of leaders, organizations, and warfighting concepts. First, we consider in detail critical roles of each in coping with uncertainty. Next, we explore the concept of exploiting uncertainty.

Leaders

Character and Competence

Strong leadership is the most important element of combat power and resilience. Trustworthiness is the most critical element of leadership. Trustworthy leaders who set the example in character and competence, who can articulate a coherent vision and sound plans to realize it, and who can make good decisions and communicate them clearly to generate meaningful action, provide important balance and equilibrium to an organization.[5]

Personal example in war coupled with belief in the leader's character and competence are powerful forces of stability and effectiveness, as we have seen throughout the study. The combination of physical presence and trust are crucial.

Leadership can add fiber and resilience to arrest the effects of erosion in physical and psychological strength and endurance. Examples abound in the history of war of leaders sustaining their soldiers in the most extreme circumstances. The example of Lieutenant Colonel Herman Balck, commander of an infantry regiment in the 1st Panzer Division in France 1940, illustrates powerfully the role of leadership in the face of physical and psychological exhaustion.

> The troops were over-tired, having had no real rest since the 9th of May [seven days ago]. Ammunition was running low. The men in the front line were falling asleep in their slit trenches. Balck himself, in wind jacket and with a knotty stick in his hand, told me [Guderian] that the capture of the village had only succeeded because, when his officers complained against the continuation of the attack, he had replied: "In that case I'll take the place on my own!" and had moved off. His men had thereupon followed him. His dirty face and red-rimmed eyes showed that he spent a hard day and a sleepless night. For his doings that day he was to receive the Knight's Cross. His opponents ... had fought bravely.[6]

At the same time, studies of combat stress and cohesion in Chapter 6 show that lack of faith in the leader can have debilitating effects on the psychological state of the organization, even if the leader is physically present. The power of personal example in the danger and stress of war should cause us to be cautious about arguing that cybernetic presence or detachment from the fight is permissible in the "information age."

While physical courage is important, the study of uncertainty also suggests the criticality of intellectual and psychological courage. The most compelling and robust argument for such courage actually comes from Clausewitz's discussion of "Military Genius." The essence of military genius, he argues, exists in the combination of "mind and temperament."[7] Only the military genius, he suggests, can cope with the uncertainty and friction of war. The commander must have a "sensitive and discriminating judgment" to "scent out the truth." That intellect must be able to orient on the light of

truth even in the darkest hours, and have the "courage to follow this faint light wherever it may lead."[8]

Intellectual courage is absolutely crucial. The commander must have an open mind in order to scent out the truth. He must be able to work through his own biases and experiences as well as ambiguous and conflicting information and assessments in order to retain visibility on the situation as it actually is rather than what it merely appears to be. At the same time, the open mind must be balanced with steadfastness and determination to make a decision and see it through to the end. Wavering back and forth between conflicting reports and assessments can lead to intellectual paralysis, the inability to make a decision, or the haphazard oscillation between decisions in which one conflicts with others and leads to confusion in the force. Cognitive imbalance can generate chaotic behavior in the organization and loss of faith in the leader.

Determination to see a sound decision through to the end, despite conflicting information, temporary setbacks, and self-doubt, is critical in maintaining balance in pursuit of the goal. The commander requires a "sense of unity and power of judgment raised to a marvelous pitch of vision"[9] to pursue the "inner light" to the very end. Obstinacy and failure to keep an open mind should not be confused with determination. Just like the inability to cope with complexity and ambiguity, they can lead to the pursuit of a plan that is completely at odds with reality on the ground. Intellectual courage, in essence, is strength of mind balanced between the extremes of irresoluteness and rigid obstinacy.[10]

Similarly, the commander must possess psychological courage to cope with emotions in the environment of war. "Since in the rush of events a man is governed by

feelings rather than by thought, the intellect needs to arouse the quality of courage, which then supports and sustains it in action."[11] The commander must have self-control, a sound temperament, and a strong character that "*will not be unbalanced by the most powerful emotion.*"[12] Psychological courage, emotional balance, becomes an internal counterweight to the fears and excitements that can result in disequilibrium in war.[13] Psychological courage also gives one the ability to tolerate the presence of opinions and assessments that are different from one's own.[14]

Commanders must develop intellectual and psychological courage in order to maintain balance and equilibrium in war. Such qualities are a habit, as Aristotle argued. Military education systems as well as professional development in the field must help leaders develop those elusive and challenging qualities. They must focus on developing intellectual and psychological depth that provide the capability to cope with ambiguity and complexity and arrive at sound assessments and conclusions in the most stringent circumstances. The development of such depth is indeed a far cry from the tendencies toward school solutions and focus on process. Military education cannot afford to be a contradiction in terms.

Vision and Plans

Coherence of vision and plans is another key element that leaders use to cope with uncertainty. To have coherent and meaningful vision, leaders must have the capability to cope with the ambiguities and complexity of war. Otherwise, vision can be radically out of step with reality. At the same time, leaders must be able to craft vision and plans that are flexible and robust enough to withstand the fluidity and dynamism of war. Finally,

they must be able to communicate vision and plans in a way that creates mutual understanding and synergy throughout the organization. Such mutual understanding sets the conditions for meaningful initiative and increased tempo in war.

Essentially dispersed knowledge in Hayek's extended market order can powerfully increase combat power of an organization if people are disciplined and trusted to make decisions in the face of opportunity and act upon them. Initiative, when in synergy, can enhance significantly battlefield performance against a slower and more rigid enemy. Initiative, as we have seen, can also be a source of friction. Developing leaders who can handle such uncertainty is crucial.

Plans must also account for the uncertainty of war. They must be flexible enough to handle complex adaptation.[15] Too often combatants tend to script-write, forgetting that the enemy has free will and a vote, or they mirror-image, assuming the enemy will react to stimuli and make decisions using the same frameworks as they do. The ramifications of such fallacies are exacerbated when they lead to rigid assumptions about what the enemy will do and how the enemy will react. Particularly prevalent among weak leaders and staff officers, the notion of "predictive analysis" comes to imply the need to establish an authoritative prediction of the enemy's actions. Inability to perform nuanced thinking or to keep an open mind, coupled with perceptions that being right means to omnisciently read an enemy's mind, leads often to the very problems of dysfunctional analytical bias psychologists see routinely.

The best plans are constructed based on multiple options and events for enemy and friendly forces rather than single, authoritative, and prescriptive plans that are blind to interactive complexity. In this way, the intellectual focus is on indicators of options

and events for both enemy and friendly forces. The ability to understand the situation is consequently less likely to be inhibited by pre-formed theories, biases, and emotional investments in prediction.[16] Such a focus also helps one to identify opportunities, to read success and lack of it more clearly, and to generate activities that capitalize on opportunity. At the same time, it is important to recognize that the complexity of war will defy even the most thorough and flexible plans. As one theorist notes, "Although competent planners will attempt to allow for all the other sources of friction to the best of their ability, their own errors will add one more."[17] Put simply, leaders must be intellectually and psychologically equipped to handle complexity and uncertainty, just as they must have the physical endurance to cope with exhaustion.

Wisdom

Leaders who possess character and discriminating judgment, intellectual and psychological depth and courage, and expert knowledge in their profession, as well as cultural, political, and diplomatic understanding, have the capacity for wisdom – the critical element in sound decision-making.[18] Information is important, to be sure, but sound decision-making has far more to do with the wisdom of the decision-maker than the quality or quantity of information. "Historical and other studies on the nature of military command," suggests Martin van Creveld, "have noted that commanders vary a great deal in their ability to master the machine over which they preside in order to obtain the military outcomes they prefer."[19] The concept of information superiority – the capability to collect, process, and disseminate an uninterrupted flow of information while exploiting or denying an adversary's ability to do the same – is meaningless without the

existence of the complementary wisdom in the decision-makers.[20] The US military's *Joint Vision 2020* indeed argues persuasively for the development of leaders, organizations, and warfighting concepts that can translate latent capabilities offered by technology into meaningful effects on the battlefield.[21]

Joint Vision 2020 also suggests the criticality of "decision superiority" – better decisions arrived at and implemented faster than the enemy can react.[22] While such capability is important, we realize it is again no panacea once we understand uncertainty.[23] The enemy has a vote in the speed and quality at which his decisions are made and implemented. Believing that decision superiority is automatic and will lead inexorably to the enemy's cognitive collapse is dangerous. Such assumptions create unrealistic expectations that can have a detrimental effect on our own cognitive balance when they do not come to fruition. At the same time, the study of uncertainty reveals that sound decisions do not always lead to good outcomes. Our leaders must be psychologically prepared for that reality.

In France 1940, the French 55th Division commander arguably had information superiority relative to Guderian during the critical Meuse crossings and fight in the Sedan area of operations.[24] He even made sound decisions that, if implemented by lethal, agile, and resilient organizations, could have altered the outcome of the battle there. His sound decisions, however, had poor results. Information and decision superiority, while important, are meaningless without the presence of lethal, agile, and resilient organizations to implement them. Even then, symmetry between quality of decision and outcome is only more likely, but not guaranteed. Possessing the depth to cope with complexity is critical for leaders in the paradoxical world of war.

Mutual Understanding

This study of uncertainty has also suggested the criticality of communication in coping with uncertainty and sustaining the cognitive and psychological balance of the organization. Information technology can assist greatly in this regard. Collaborative planning tools and whiteboard conferences can enhance understanding through the synthesis of verbal, visual, and written communication. At the same time, however, remote communication cannot convey the body language and other subconscious forms of expression that are so crucial in making assessments on the condition of the moral factors in subordinates and organizations. Furthermore, studies of human communication indicate that people who know each other well and have developed mutual understanding are more likely to communicate effectively than people who have little familiarity with one another. Better tools by themselves will not necessarily lead to mutual understanding.

Better situational understanding throughout the organization does have the potential to help sustain equilibrium in an organization. As S.L.A. Marshall's study of panic indicates, frictions in communication can lead to misunderstanding and to unintended dysfunctional behaviors in the confused bewilderment of combat. Leaders play a critical role in letting their subordinates know *what* and *why*. Soldiers who understand what they and others are doing and why their performance is important are far more likely to function effectively than those without such understanding.

Situational understanding by itself is no panacea. Sound understanding of a situation that seems hopeless can generate panic. Conversely, as the examples of the Lost

Battalion and Lyle Bouck's platoon indicate, understanding that a situation is seemingly hopeless can generate the opposite reaction. Situational understanding is important; the moral factors are critical.

Information and understanding in the hands of subordinate leaders can also enable Hayek's extended market order to come to fruition in war. As our study has shown, different people can see the same picture or have the same information and come to completely opposite conclusions. If knowledge is "essentially dispersed," then it makes sense to enable disciplined, trained, and wise subordinate leaders to make decisions consistent with the goals and intent of the operation. In the extended order, people can "see" and comprehend information differently than those further removed from the scene of action. In terms of coping with uncertainty and restoring balance to an organization, subordinate leaders on the scene are far more likely to recognize the state of moral factors on the ground and to take action to sustain equilibrium than more detached leaders further removed in space, position, and connection.

The critical factor, once again, is the nature of the leader on the scene. An imbalanced leader on the scene can take actions that exacerbate the problems rather than cure them, as we witnessed with the German parachute battalion and regimental commanders that faced Bouck's platoon in December 1944. In that case, a visit from a leader further up in the chain of command might have energized the organization. In the event, it took a heated Lieutenant Colonel Joachim Peiper, leader of *Kampfgruppe Peiper* (the German main attack in the Ardennes counteroffensive), to generate purposeful activity in the regiment the next morning. We will return to the extended market order theme when discussing exploiting uncertainty later in the chapter.

Cohesion in Organizations

Studies of the human dimension of war suggest that the development of unit cohesion is critical in sustaining the balance and equilibrium of the moral factors of an organization in war. Unit cohesion exists when an organization possesses discipline, comradeship, and faith and trust in the leadership. Resilient organizations are strong in the physical, cognitive, and psychological domains.

Organizations that lack cohesion are brittle. Their stability is not resilient, so they exist on the sharp edge of chaos and disequilibrium. Such organizations are most sensitive to changes in initial conditions. Overly centralized and authoritarian organizations can oscillate chaotically when the leader is removed or is seen as illegitimate. High tempo operations that alter the delicate physical, psychological, or cognitive balance can generate chaotic behavior in a fragile organization.

It is important to note, however, that our actions, while necessary to create imbalance in the enemy, are not sufficient. The descent to chaos or the reestablishment of equilibrium is dependent upon the nature of the enemy. We must exercise caution before establishing expectations of enemy collapse that fail to account for the totality of interaction. The enemy gets the critical vote on whether equilibrium or chaos will exist.

Cohesion must exist at all levels of the organization. We can readily understand the criticality of comradeship among the primary group – the squad, crew, or section. We must also understand the criticality of comradeship *between* primary groups and other organizations. Primary groups and military organizations do not exist or fight in isolation.

They are part of the larger organizational context. Mutual faith and trust must exist between these organizations. Suspicion and doubt about the capabilities of an adjacent or supported unit can lead to imbalance within an otherwise cohesive organization.

The French 55th Division, for instance, employed the "plug and play" approach to unit cohesion, assuming that like units could be mixed and matched all over the battlefield with no impact on effectiveness. In the defensive positions along the Meuse River were platoons, companies, and battalions from different organizations that were haphazardly mixed together. A lack of mutual faith and trust persisted among these disparate units. There was a constant fear from doubts about whether the units to the left and right would fight. Trepidation over whether the artillery would fire on time and in the right location must have been pervasive throughout the division. In the rear there existed worry about whether the front-line units could hold against the Germans.[25] The fact that panic in the front lines began almost immediately in the 55th Division and spread rapidly through the artillery, suggests the ramifications of the lack of mutual trust in the patchwork organization. The experience of the 55th Division, as well as other examples of patchwork organizations, should force us to examine critically and with skepticism arguments that suggest the information age has made unit cohesion unnecessary. To the contrary, the increased dispersion of the battlefield possible with information technology, when coupled with understanding of the human dimension of war, argues forcefully for an even greater attention to unit cohesion.

To be sure, one must determine at what level and below unit cohesion is absolutely crucial and then attain a sense of balance within an organizational structure based on that understanding. At that point it is possible to organize the assets and

capabilities of the organization intelligently. Studies of land forces indicate that the critical level is brigade or regiment.[26] An organic, combined arms capability at that level is demonstrably feasible and effective. The unit must be robust enough to assimilate additional attachments; but the critical issue is that it must have the organic capability to fight, support, and sustain itself in a general combat situation. Air and naval forces most likely have a different organizational threshold, but discovering that is equally important.

Organizations implement decisions. While devoting resources to the development of information technology, planning tools, and decision aids is important, we must not forget that in real war discontinuities exist between decision, action, and outcome. Resilient, agile, and lethal organizations are necessary to reduce the bounds of discontinuity and at the same time cope with the complexity of war. Organizations and their leaders on the scene can act to rectify the discontinuities, restore equilibrium and balance, and create or exploit opportunities for victory. They are the key to the existence of a self-regulating and self-correcting system that is crucial in war. Hayek's extended market order once again becomes critical in understanding the importance of organizational excellence. Self-regulating and synergistic behavior is possible in a decentralized organization. It can respond more quickly to sustain balance or exploit opportunity. Centrally directed organizations are likely to suffer a fate similar to the centrally directed economies of failed communist states in the 20th century because they cannot alone cope with the complexity of war.

While most attention has been placed on the cognitive and psychological domains in the study of uncertainty, it is important to remember the critical physical component of resilience. The physical viability and strength, as we have seen, affects the cognitive and

psychological domains. We must be pay attention, therefore, to creating organizations that possess structural resilience. There exists a threshold beneath which an organization will become brittle with the onset of casualties. Removing the "slack" in the system, cutting the size of organizations to the smallest possible or removing subordinate units that give flexibility to the organization, might create structural fragility from which it becomes impossible to recover.[27] Greater ranges of visibility and lethality might enable the size of organizations to be reduced, but such reduction must be viewed in light of the threshold of structural fragility. Fragile organizations, whether in the physical, cognitive, or psychological domains, are the most susceptible to having adverse nonlinear outcomes.

Warfighting Concepts

War's inherent uncertainty might seem to suggest the fallacy of establishing doctrine and warfighting concepts.[28] Indeed, doctrinal constructs such as the French Methodical Battle were so far out of step with the new realities of mechanized warfare that they created false expectations that contributed significantly to the cognitive and psychological imbalance and chaos in May 1940. Doctrine that is rigidly prescriptive can set the conditions for disequilibrium in war if it is out of step with reality.

At the same time, however, doctrine and warfighting concepts can add predictability, routine, and mutual understanding in the confusion and complexity of battle. In the study of soldiers and organizations in combat, we have seen the importance of battle drills that are second-nature to combatants and the value of an underlying

structure to plans and operations that add comprehensibility and a sense of legitimacy. In periods of confusion and chaos, a return to constructive habits, such as battle drills, can restore balance and equilibrium in a soldier or organization. The German noncommissioned officer, Vince Kuhlbach, who took charge of a patrol at dusk and captured Bouck's platoon is one example. By following simple doctrinal precepts such as move concealed and attack the enemy from the flank or rear, and by executing the movement there in recognizable method and formation, he restored a sense of equilibrium and balance – and ultimately effectiveness – to those around him.

Doctrinal constructs provide a critical structural underpinning that enable people to make sense of the operational concept and their role within it. To eliminate doctrine would be a foolish response to uncertainty. Doctrine provides the grammar that makes the art of war comprehensible.

Doctrine and warfighting concepts must promote agility, freethinking, and flexibility while at the same time creating understanding. They must be permissive rather than restrictive. Sound and resilient doctrine and warfighting concepts do not promote rigid checklists and school solutions that restrict creative thinking. Instead, they provide the structure by which creativity becomes meaningful and can be understood. The powerful synthesis between creativity, understanding, and immediate and precise execution of battle drills provides a resilient and elastic structural framework with which organizations can sustain equilibrium while maximizing the pulse and tempo of war.

Creating and Exploiting Disequilibrium and Imbalance

Leverage

Resilient leaders, organizations, and warfighting concepts provide combatants the wherewithal to cope with uncertainty and sustain balance and equilibrium in the confusion and chaos of war. To be most effective, however, combatants must also work to deliberately create and exploit imbalance and disequilibrium in the enemy. While no recipe or checklist can exist here either, the study of uncertainty does lend some insights.

The theory of complexity in Chapter Eight suggests that increased numbers of meaningful interactions adds complexity to war. A meaningful action is one that is directed towards and has effects upon a point or points of leverage important to the enemy. A meaningful interaction results, therefore, in interaction on at least one level. The enemy cannot simply ignore it. Complexity results when the meaningful interaction generates interactions on more than one level, and in which no single, simple solution exists to solve the problem or problems created by our actions. Points of leverage can be understood as centers of gravity in the Clausewitzian sense. Complexity and nonlinear theories also suggest the importance of targeting initial conditions – directing operations against the physical, psychological, and cognitive domains. Applying meaningful effects against more than one of those domains will again add to the complexity of the fight and can perhaps even result in interactions that affect all three. The bottom line is to threaten something, or preferably many things, that the enemy cannot do without.

Creating meaningful effects means that we must know the enemy. We need to know or discover those points of leverage or centers of gravity and sensitive areas in the three domains and attack them relentlessly. At the same time we are adding complexity

we need to look for opportunities – points at which effects are creating imbalance – and exploit them so we do not give the enemy a chance to recover. We must maximize the amount of complex pressure on the system at multiple critical points and to continue doing so until imbalance and chaotic behavior results. Once disequilibrium begins, we must continue the pressure in order to prevent the system from recovering. This is the best chance for inducing dysfunctional nonlinear effects. While the will to fight is the enemy's choice, our operations can set the conditions that make generating the will to fight as difficult as it possibly can be. If the enemy retains the will to fight, generating meaningful effects on multiple points of leverage relentlessly and generating maximum complexity, while sustaining our own balance and protecting our own points of leverage, offer a sound method for achieving a favorable outcome. Although we prefer a quick decisive victory and need to create the conditions in which it is possible, the enemy does not always offer one.[29]

Effects: Reconciling Attrition and Maneuver

Viewed from the complexity angle, the apparent dichotomy between attrition and maneuver is reconcilable. The focus of our operations must be based on meaningful effects directed at multiple points of leverage that are nested at the tactical, operational, and strategic levels of war. In some cases, the best method to achieve effects will be through physical attrition by precision munitions; in others agile land forces operating at an asymmetrically high tempo will be the best method. Complexity theory, however, indicates that we can maximize the enemy's uncertainty and create the best chance for

inducing dysfunctional behavior through a balanced approach among air, sea, and land forces. Alone, each type of force presents only a simple or compound problem for the enemy. Employed in unison, the forces have the greatest potential to generate complexity. Employed synergistically in which meaningful effects at multiple points of leverage are nested at the tactical, operational, and strategic levels of war, our forces have the best capability to increase complexity to a point at which the enemy can no longer successfully cope.

Cognitive and psychological effects may begin to take hold subtly as the uncertainty mounts in the enemy. Poor enemy decision-making, as Boyd expressed, or psychological panic as soldiers begin to flee or hide, may serve as indicators that the delicate balance of moral factors is becoming unstable. At this point, balanced capabilities become absolutely crucial for US forces. As vulnerabilities and opportunities appear on the battlefield, the commander will have the capability to exploit them as best fits the situation. The presence of a lethal and agile ground force in the area of operations, for instance, might have paid dividends in capturing or killing Taliban and Al-Qaeda forces more effectively during Operation Enduring Freedom. When employed effectively, balanced capabilities generate complexity, add to the enemy's uncertainty, and offer US forces multiple options to exploit opportunities.

Transitions

Balanced forces also provide commanders the opportunity to dominate transitions in war. Transitions are characterized by pauses in war as each side prepares for a subsequent operation. The period between initial deployment and the conduct of

offensive or defensive operations is a transition. The pause that results when an offensive operation culminates and the unit prepares to defend or resume the offensive is another type of transition. Likewise, the period between conducting a defensive operation and a subsequent offensive operation is a transition. These transition periods, and others like them, are typically times when an organization can recover and restore equilibrium.

Studies of combat psychiatry and nonlinear dynamics indicate that disproportionate outcomes due to cognitive or psychological collapse occur when the system, whether the human or the organization, does not have time to recover equilibrium. Our ability, then, to sustain constant pressure against the enemy's points of leverage becomes crucial. We must possess the capability to deny the enemy periods of rest in transitions between offense and defense or between successive offensive or defensive operations. To do so, not only must we have a balanced force, but a force robust enough to win the initial fight and then commit fresh units to maintain pressure during the transitions while the previously engaged units recover.

To induce nonlinear outcomes through cognitive and psychological collapse we must have forces with the physical wherewithal to dominate both the main force battle and the transition fight. There seems to exist, therefore, an organizational threshold for the management of transitions. Below a certain number of robust subordinate units, the organization cannot dominate both fights. The US Army, for instance, can employ cavalry forces to dominate transitions in war. These forces are traditionally organized and equipped to operate autonomously in a geographically dispersed manner to cover the entire battlespace of their parent unit. Intelligently employed, cavalry organizations give army divisions and corps the capability to dominate transitions and thus set the conditions

to induce adverse nonlinear effects on the enemy. The enemy determines whether he will collapse cognitively or psychologically, but our capability to nest meaningful effects at the tactical, operational, and strategic levels and to dominate the transitions in war to deny the enemy the ability to recover equilibrium will stretch the moral factors of the enemy to the limit.

Initiative and Control

Hayek's extended market order and the concept of essentially dispersed information suggest that decentralized forces can possess a decided advantage over centrally directed forces provided the proper conditions are in place. As has become evident throughout this study, discontinuities are present in the OODA cycle that can cause frictions in the seemingly simple and linear decision-action-outcome paradigm. Even the best and most rapid decisions from the situationally aware commander might not be implemented as envisioned (or implemented at all). Even if implemented as envisioned, the nature of war shows that the outcomes of interaction are often far different than we predict. As these complexities mount and interact with our own assumptions and biases, our ability to recognize these discontinuities and the challenges and opportunities they present can be quite limited. This is particularly true if we are operating on the tacit information of only a single person or some sort of politburo.

Decisions made at lower levels, in which decision-makers are in direct contact with the ones who must enact decisions, have the better chance of being implemented as envisioned. Decentralized decision-making and execution capitalizes on the tacit

knowledge of myriad individuals in the essentially dispersed environment of war. Even in an organization in which information and communications technology is ubiquitous, the most rapid method of executing the decision-action cycle is when authority is delegated to the lowest levels.

Two critical problems with such an approach are obvious. First, experience and perspective tend to decline as we move down the chain of command, so the likelihood that poor decisions will be made arguably increases. Second, independence can unravel the careful synchronization of an operation, resulting in a less effective application of force. Clear, therefore, is the need to set the right conditions for independent decision-making and a balance between initiative and synchronization.

Discipline, trust, and mutual understanding between senior and subordinate are crucial before independent decision-making can be constructive in war. The degree of independence granted to a subordinate is directly proportional to the confidence the senior has in delegating it to the subordinate. No formula or recipe can dictate the balance; it belongs to the singular time and place of the context and relationship. The better the seniors cultivate the right atmosphere and train subordinates to read the fight and make decisions, the more agile and capable of recognizing and exploiting opportunities their force will be.

Open and honest communication between senior and subordinate are key in promoting the capability to dynamically re-synchronize the fight when necessary. Information technology can provide the means to enhance the pace and reliability of communication as well as the ability to quicken the process of redirecting critical organizations and resources to capitalize on opportunity. Mutual understanding must be

present beforehand, but better fidelity in communications and the increased capability to make timely adjustments to plans can help provide the right balance between initiative and synchronization. The result can be a significant increase in agility and effectiveness as we gain greater fidelity in adapting to and exploiting the complexity of war.

Deception

Studies of how people process and interpret information with their cognitive maps and through their perceptual lenses indicate that deception can be a powerful tool in creating uncertainty for the enemy. People, as we have seen, form theories and conclusions about the meaning of information quickly, and they require far more contradictory information to overturn an existing construct than they required to create it in the first place. What these observations suggest is that the most effective deceptions are those that fit into an existing enemy construct.

The deception plan built around General George S. Patton as a part of Operation Overlord in World War Two was a classic example. The Germans were convinced that the Americans had more forces in England than were actually present and were convinced that Patton would lead the main attack across the English Channel at the narrow Pas de Calais. The Allied deception plan fed directly into these assumptions. They created a deception and simulated an entire army commanded by Patton that would land in France after the D-Day assaults. The plan worked, tying up German reserves in France as they awaited Patton's landing in the Pas de Calais while the forces in Normandy worked their way inward. The deception played on the perceptions and biases

of the Germans, and the latter did not recognize the ruse until it was too late to defeat the Normandy landings.

Understanding the bounded rationality of the enemy is crucial for deception to work. We need to understand how they see the world, what they believe is our most logical course of action, and play on those perceptions and biases. In short, the most effective deception is when we show the enemy what he wants to see. Deception can exacerbate uncertainty by expanding the bounds of complexity with which the enemy must cope in war.

Conclusion

Coping with uncertainty requires resilience to keep the physical, psychological, and cognitive domains in balance. Creating uncertainty in the enemy can be accomplished by increasing the complexity of the war through balanced application of force against critical points of leverage to gain meaningful effects. Exploiting uncertainty requires the ability to recognize opportunity; the possession of an agile, lethal, and balanced force that can operate in all contexts at an asymmetrically high tempo; and the wherewithal to dominate both main force fights and transition periods in order to prevent the enemy from recovering. Whether we must win by destroying the enemy physically over time, or whether we can induce cognitive or psychological collapse, is dependent on the nature of the enemy. Nonetheless, maximizing complexity can set the conditions for inducing nonlinear outcomes that work in our favor.

Understanding the uncertainties intrinsic to war can also help us design theories of victory that offer the best chance of success.

Chapter Ten

Conclusion: Where Do We Go From Here?

Significance

Predictions of uncertainty's demise are premature. As long as human beings are involved in war, conflict, and combat (and nearly any other interactive endeavor), uncertainty will be close at hand, tugging at the minds and emotions of the participants. This exploration into the realm of uncertainty should open new pathways for understanding war, combat, and conflict.

The synthesis created from analyzing the human, nonlinear, and interactive dimensions reveal war as a bold tapestry with subtle and complex nuances deceptively hidden by stark and violent overtones. Too often, analyses of battle anoint simplistically a single piece of technology or method of operations as holding exclusive explanatory power for the outcome. When such ideas become dogma, intellectual stagnation and irrational exuberance combine to propel a military toward a crisis of expectations that can lead to disaster. Anti-intellectualists remain transfixed in simplistic appreciation for what appears to be obvious from a distance. In war, however, the bold images of the tapestry become illusory. As we move closer, their shape changes over space and time and with perspective to reveal something far different than first imagined. The appreciation that perception and reality have diverged often comes too late. At the same time, there exists the less prevalent risk of seeing only the microcauses while failing to comprehend the larger picture. Being lost in the world of dynamic minutiae, some people are unable to step back and see the greater meanings and forces staring them in the face. They cannot

see the forest for the trees. Overcome by nuance and subtlety they lose the courage to act.

Understanding war requires an intellectual perspective that at the same time appreciates stark boldness and underlying complexity. Appreciating war's uncertainty can help bring each into greater focus. It should inform theories of war and the development of warfighting concepts. It should shape how we develop our leaders and our organizations. It should provide insight into what types of technologies to develop and the criticality of balancing investments in equipment with those for education and training.

Consequences for Theory

A recurring problem in military theory is the omission of any thoughtful analysis regarding interaction. One common tendency is to view war as an uncomplicated progression of decision-action cycles in which we are naturally faster and better and the enemy is slower and less capable. This tendency sees a neat, liner progression from decision to action to outcome that fails to account for any interaction that might interrupt the cycle or throw us off balance. A related tendency is to discount interaction completely and assume that a certain recipe of actions will lead inevitably and inexorably to victory. By omitting thoughtful analysis of interaction, such tendencies result in theories that are fundamentally misleading and flawed. An observation by mathematician Ian Stewart articulates the problem nicely, albeit in a different context.

> Classical mathematics concentrated in linear equations for a sound pragmatic reason: it couldn't solve anything else.... So docile are linear equations that the

> classical mathematicians were willing to compromise their physics to get them. So the classical theory deals with shallow waves, low-amplitude vibrations, small temperature gradients.[1]

Like classical mathematics, too many theories of war are docile.[2]

In real war a thinking, unpredictable, and determined enemy gets a vote. Simplistic prognostications of paralysis, lockout, shock, or dislocation based solely on what we propose to do to the enemy are misleading. As the previous chapters illustrate, the nature, timing, and even occurrence of psychological or cognitive collapse are determined by the nature of the enemy. Our actions provide the context to be sure, but collapse is a choice, conscious, subconscious, or unconscious, of the enemy.[3] To predicate a theory of war on the inevitability of collapse is to set up a fragile house of expectations that threatens to come crashing down when the enemy we face has the benefit of a strong will.

Furthermore, not all actions achieve the results we want or predict. The disparity between decisions, actions, and outcomes results because the forces of interaction are animate. An enemy with his own view of the world and understanding of the situation chooses independently how he wants to react. The nature of the interactive forces determines how the decisions of combatants are actualized. Interaction on each level generates an outcome. The result can be consistent with the decisions, subtly divergent, or completely at odds with them. War is fluid with such dynamism.

Theories of war and theories of victory must address interactions and effects and how they lead to the desired political outcome.[4] They must be able to make coherent connections from military operations all the way through the political end game. Failure to think through the entire process can result in significant problems in strategic

development and in the conduct of the war. Theory must account for adaptive complexity. The best theories and concepts are those that provide frameworks for us to cope with our own uncertainty while exacerbating and exploiting that of the enemy. The art of success, in the words of John Boyd, is to "appear to be an unsolvable cryptogram while operating in a directed way to penetrate adversary vulnerabilities and weaknesses in order to isolate him from his allies, pull him apart, and collapse his will to resist."[5] Theory, in short, must address the human, nonlinear, and interactive dimensions of war.

Leaders and Organizations

We must equip our leaders intellectually and psychologically for war's uncertainty. Developing in our leaders an appreciation for complexity and ambiguity and the intellectual rigor to cope with them is absolutely crucial. Learning various processes is important, but process can become an end in itself trapping the mind into restrictive modes of thinking. Developing intellectual depth enables one to rise above process, master it, and mold it to greater usefulness. Depth and insight promote creativity. Our formal and informal education systems need to provide forums that foster intellectual development. Formal education must take place over a sustained period of time. Informal education must become a habit -- a lifetime of learning. We need to provide the resources for and emphasize the value of intellectual depth and courage. There is no checklist for creative thinking.

At the same time we need to arm leaders psychologically for the uncertainty of war. Sustained study of the human dimension of war is crucial but curiously absent from

our military education systems. Leaders must appreciate the psychological demands on themselves and their soldiers in combat. They must be aware of the discontinuities in war so they are prepared to cope with divergences between expectations and outcome. In so doing, leaders will come to acknowledge the criticality of leadership from the front and practice it as a matter of habit in peace.

Competent, confident leaders capable of thinking through and coping with complexity are more likely to make sound decisions in the chaos of battle. We must develop deliberately the tacit knowledge of leaders at every level of command. The ability to recognize problems and opportunities and the wisdom and resolution to act on them appropriately will add significantly to the tempo and impact of our operations. We need to set the conditions for essentially dispersed knowledge in the extended order of combat to work decisively to our advantage.

Developing and promoting leaders who have the intellectual and psychological depth to cope with the demands of war are critical. In the contemporary environment in which conflict can arise, escalate, and terminate rapidly, we may not have the luxury of using a macabre form of combat Darwinism to get the right leaders in the right positions. That seemingly successful peacetime officers have proven impotent in war should energize us to narrow actively the gap between the types of people we tend to value in peace and those we need in war. To be sure there are some unique people who can thrive in one environment but not the other. Nonetheless, by coming to greater understanding of what we require in leaders in time of war we can do a better job developing them in times of peace.

At the same time we must also foster cohesive organizations that possess the resilience to cope with uncertainty and the agility to exploit opportunity. As the US Army experiences time and time again at combat training centers, adhocracy is largely ineffective. This exploration into uncertainty in war lends further insight into why this is so and why greater information technology will do little to rectify the situation. The most cohesive, lethal, and agile organizations are combined arms teams that live, work, and socialize together. The members of such organizations understand one another on levels that are impossible to replicate cybernetically. We need to move forward in the process of organizing our units as organic teams that can function across the spectrum of conflict. Attachments of critical assets from outside units are inevitable and necessary for each unique situation. Nevertheless, establishing the right structural foundation on which combat organizations are formed will increase effectiveness and enhance the capability to absorb external assets more seamlessly.

Mutual trust developed through rigorous training and sound leadership is absolutely essential. Training requires repetition and resources. It is expensive. We cannot afford to neglect training in favor of technological development. Forging and sustaining organizational excellence is a time consuming and resource intensive process, but trained soldiers and organizations are the ones who can employ technology successfully. Equipment does not possess autonomous effectiveness. As German General Hermann Balck explained, "war is never a technical problem only, and if in pursuing technical solutions you ignore the psychological and the political, then the best technical solutions will be worthless."[6]

Cohesion also requires personnel stability. Bonds between people and among organizations are developed over time and through experience. The constant shuffle of individuals to different units militates against cohesion. We need to create personnel policies at every level of command that contribute toward rather than detract from unit cohesion and combat effectiveness.[7]

Technology

The examination of uncertainty in war suggests that we should focus technological development on areas that add tempo and lethality to military operations. Information technology is important in both regards. At the same time, we need to be realistic about what technology can and cannot do. Proclaiming that technology can cure uncertainty or eliminate the human dimension of war is foolish. At best it leads to counterarguments and ideas that seek to discredit the technology altogether while being blind to its real potential. At worst, such prognostications, if they become dogma, can lead to a wasteful diversion of resources, inappropriate warfighting concepts, and can set up a crisis of expectations in war that can unravel rapidly. We cannot afford, on the one hand, to become like the Janissaries who rejected firearms as unmanly. On the other hand, we must avoid becoming like the French in the interwar years who developed concepts such as "methodical battle" and neglected the criticality of leadership and unit cohesion. Coming to grips with the uncertainty of war should help sustain the right balance.

Endnotes

[1] For instance, Frank M. Snyder, "Command and Control and Uncertainty." *Naval War College Review*, (March-April 1979), Admiral Bill Owens, *Lifting the Fog of War*, p. 14, 15. Robert Leonhard seems to argue along similar lines in asserting an inverse proportionality between "knowledge" and "ignorance." See *Principles of War for the Information Age*, p. 251.
[2] See Chapter Eight for a detailed examination of the Doolittle Raid.
[3] Sun-Tzu, III.31.
[4] Owens, 15.
[5] Alberts, Garstka, and Stein, *Network Centric Warfare*, 12.
[6] Williamson Murray, "Introduction," in Robert H. Scales, *Future Warfare Anthology*. Carlisle, PA: Strategic Studies Institute, 1999. p xvii; see also Robert H. Scales, *Future Warfare Anthology*, p. 71.
[7] Lieutenant General Paul K. Van Riper, "Information Superiority." Statement before the Procurement Subcommittee and Research and Development Subcommittee of the House National Security Committee in Congress, 20 March 2001.
[8] Owens, 14.
[9] Paul Van Riper and Robert H. Scales, "Preparing for war in the 21st Century," *Parameters* (Autumn 1997), 14.
[10] Owens, 18-20; "Network-Centric Operations: DoD Report to Congress," August 2001. The 14-15 August 2001 "Network-Centric Warfare" Symposium at the Naval War College contained several presentations that suggested the need to "remove impediments to change" and to "get on board" with the coming revolution. Whether intentional or not, the implication that skeptics were "impediments to change" and must be "removed" was not lost on a number of officers in the audience.
[11] Van Riper and Scales, 5.
[12] *Joint Vision 2020*, the governing vision for the US armed forces, asserts, "We must remember that information superiority neither equates to perfect information, nor does it mean the elimination of the fog of war. Information systems, processes, and operations add their own sources of friction and fog to the operational environment..." (*Joint Vision 2020*, p. 9-10). Still, *JV 2020* offers no explanation of why uncertainty would exist in future war, and seems not to recognize that uncertainty is a bigger problem than informational challenges.
[13] I will use several historical examples, but will examine the Breakout at the Meuse River during the German invasion of France in 1940 and the engagement between an American platoon and a German regiment on the first day of the Battle of the Bulge, 16 December 1944, in the greatest detail. I do so not because I believe these two engagements to be representative of all war, but because they are the examples of which I have the most detailed understanding. I have studied them for the past five years and have led two staff rides of the battlefields. The detailed analysis enables me to draw out some of the salient uncertainties in the human, nonlinear, and interactive dimensions in those engagements.

Chapter Two
[1] Handel, *Masters of War*, pp. 231-253.
[2] For a discussion of the Era of Warring States and the manner in which war was waged in that time see Samuel B. Griffith's introductory essays in Sun Tzu, *The Art of War*, pp. 20-44.
[3] Sun-Tzu, III.31.
[4] Ibid., I.3.
[5] For use of spies see Ibid, XIII. 1-23.
[6] Ibid., III. 1-4. Quoted in Handel, *Masters of War*, p. 233.
[7] Sun-Tzu, VI. 1-31.
[8] Ibid., VI. 26; XI. 45.
[9] Ibid., VI. 24.
[10] Ibid., III. 3, 11. It is important to note that Sun-Tzu is not advocating "bloodless" victories out of some sense of compassion. His desire to take a state in tact without fighting is based on the cold realities of politics in the Era of Warring States. Sun-Tzu's China consisted of myriad independent warlord states each

vying for hegemony. A bloody battle between two states would exhaust the victor and leave both the victor and vanquished vulnerable to a third predator state. Taking an enemy state in tact without fighting would, conversely, add measurably to the strength of the victor.

[11] Handel, *Masters of War*, p. 237.

[12] Sun-Tzu, I.14, 28, IX. 46; Handel, *Masters of War*, p. 236

[13] Handel, *Masters of War*, p. 236.

[14] Sun-Tzu, VI. 30.

[15] Ibid., VI. 29.

[16] Ibid., V. 21.

[17] Ibid., V. 19.

[18] Ibid., IV. 1-4.

[19] For a discussion of Clausewitz's life and ideas see Michael Howard, *Clausewitz*; Raymond Aron, *Clausewitz: Philosopher of War*; and Peter Paret, *Clausewitz and the State*. For a discussion of ideas relating to bounded rationality in Clausewitz's time see Georg Wilhelm Friedrich Hegel, *The Philosophy of History*, pp. 1-102.

[20] Herbig, "Chance and Uncertainty in Modern War," p. 103.

[21] Unfortunately, the Prussian thinker could only rewrite the first few chapters of Book I before his untimely death in 1831. See the introductory essay by Peter Paret in *On War*, p. 4.

[22] Handel, *Clausewitz and the Modern State*, p. 7.

[23] Ibid., 18-23.

[24] Ibid., 78.

[25] Clausewitz's theory also lends itself to analysis in the nonlinear dimension. I will explore Clausewitzian nonlinearity in the larger discussion of nonlinearity in Chapter Seven.

[26] Herbig, 96.

[27] Clausewitz, p. 101.

[28] Ibid., p. 104.

[29] Ibid., pp. 119-121.

[30] Handel, *Masters of War*, p. 428, note 24.

[31] Clausewitz, p. 117; Quoted in Handel, *Masters of War*, p. 237.

[32] Ibid., p. 102.

[33] Ibid., 117.

[34] Ibid., p. 86; Handel, *Masters of War*, p. 245.

[35] Ibid., p. 78-89.

[36] Ibid., 75-77.

[37] In terms of absolute war, Clausewitz discussed three interactions and three "extremes": 1) there is no logical limit in theory to the application of force as each side tries to outdo the other, 2) war will continue, in theory, until one side has completely disarmed the other, and conversely that the other side will resist until completely disarmed, 3) combatants will, in theory, maximize their means and will until war becomes fought with total means and will because they assume the opponent will do the same. Clausewitz, 75-77. As we will discuss in Chapter 4, Clausewitz has postulated a sort of proto-game theory in his discussion of the extremes and interactions that lead to abstract war.

[38] Ibid., p. 78. He did argue that war would achieve its "perfection" if "(a) war were a wholly isolated act, occurring suddenly and not produced by previous events in the political world; (b) it consisted of a single decisive act or a set of simultaneous ones; (c) the decision achieved was complete and perfect in itself, uninfluenced by any previous estimate of the political situation it would bring about." The notion that such conditions would be met is fundamentally absurd.

[39] Ibid., 80. Clausewitz clearly regards strategic intelligence as crucial in the ability to form plausible estimates. Far from discounting intelligence, Clausewitz regards it as foundational. The problem, as we will see later, is not so much in gaining "reliable information" as it is in how we interpret such information, particularly with the friction of war added in the balance. Michael Handel, however, suggests (I believe incorrectly) that Clausewitz is only "one step removed from the complete neglect of intelligence and its potential" (*Masters of War*, p. 245; *Intelligence and Military Operations*, pp. 13-21.).

[40] Ibid., p. 81.

[41] Ibid., p. 84.

[42] Ibid., p. 85-6.

[43] Ibid., p. 85-6.
[44] Ibid., p. 89.
[45] The triangle is often confused with the trinity. For the best discussion of the trinity see Christopher Bassford and Edward Villacres, "Reclaiming the Clausewitzian Trinity."
[46] Ibid.
[47] See Alan Beyerchen, "Clausewitz, Nonlinearity, and the Unpredictability of War."
[48] Herbig, p. 97.
[49] Clausewitz, p. 80.
[50] Ibid., p. 80, 86, 282-4.
[51] Ibid., p. 80. Emphasis in original.
[52] Ibid., p. 283.
[53] Herbig., p. 107.
[54] Clausewitz, p. 112.
[55] For further exploration of prevailing notions of chance in Clausewitz's time, primarily from mathematician Henri Poincaré, see Watts, "Clausewitzian Friction," p. 113; and Alan Beyerchen, "Clausewitz, Nonlinearity, and the Unpredictability of War," pp. 77-82.
[56] Clausewitz, p. 86.
[57] Ibid., pp. 101-2.
[58] Ibid., p. 101.
[59] Clausewitz argues in his section on "Relative Strength" that physical strength (numbers, organization, equipment), psychological factors, and "the talents of the commander-in-chief" (cognitive) are the components of relative strength (p. 282).
[60] Ibid., p. 184.
[61] Ibid., p. 185.
[62] Ibid., p. 282.
[63] Ibid., p. 84. For the inability to comprehend even our own situation with accuracy see p. 217.
[64] Ibid., p. 119.
[65] Ibid., 120.
[66] Watts, "Clausewitzian Friction," p. 32.
[67] Clausewitz, p. 217. The third determinant is the greater strength of the defensive.
[68] Ibid.
[69] Ibid., p. 117.
[70] Ibid., p. 117.
[71] Ibid., p. 193.
[72] Ibid., p. 134.
[73] Ibid., p. 139.
[74] Ibid., pp. 136-7.
[75] Ibid., p. 149. Emphasis in original.
[76] Ibid., p. 139.
[77] He does devote considerable attention to the effects of the physical environment on operations in his context, particularly in different types of terrain.
[78] Ibid., pp. 605-610.
[79] Ibid., p. 136.
[80] Handel, *Masters of War*, p. 240.
[81] Clausewitz, p. 193.
[82] Ibid., p. 140.

Chapter Three

[1] For the most detailed study see Daniel Kahneman, Paul Slovic, and Amos Tversky, *Judgment under uncertainty: Heuristics and biases*. See also John Cohen: *Behavior in Uncertainty*.
[2] For decision making strategies and models see Edith Stokey and Richard Zeckhauser, *A Primer for Policy Analysis*; for intuitive decision-making see Gary Klein, *Sources of Power, How People Make Decisions*. See also John S. Hammond, Ralph L. Keeney, and Howard Raiffa, *Smart Choices: A Practical Guide to Making Better Decisions*.

[3] Daniel Kahneman and Amos Tversky, "Variants of uncertainty," in Kahneman et al (ed.), *Judgment under uncertainty*, p. 509.
[4] Frank H. Knight, *Risk, Uncertainty, and Profit.* p. 199.
[5] Ibid., p. 202.
[6] Ibid., 206.
[7] See the discussion in Frank H. Knight, *Risk, Uncertainty, and Profit*, pp. 197-232. See Alan Beyerchen, "Clausewitz, Nonlinearity and the Unpredictability of War," pp. 77-82.
[8] See Knight, p. 224-5.
[9] See Watts, p. 113; Beyerchen, "Clausewitz, Nonlinearity, and the Unpredictability of War," p. 78.
[10] Ibid., see also Knight, p. 235.
[11] Regardless how many times the die is cast, the probability that the die will show a 6 is exactly the same. An uncertainty exists in terms of whether the die will show a 6 on a given roll, but probability that it will is certain.
[12] Correlation of Forces and Means (COFMs) are the mathematical tools planners use to test feasibility. Each tactical unit-type is given a mathematical measure of capability. For a given battle planners calculate the friendly and enemy unit values of each element involved in the fight, and use the "correlation" to evaluate the probable outcome of a given engagement. A 1:1 ratio favors the defender; a 3:1 attacker to defender ratio results in a tie; a 6:1 ratio favors the attacker; a 9:1 ratio portends annihilation for the defender.
[13] See James G. Roche and Barry D. Watts, "Choosing Analytic Measures," pp. 165-201, esp. p. 169, 188, 191.
[14] For instance, Frank M. Snyder, "Command and Control and Uncertainty." *Naval War College Review*, (March-April 1979), Admiral Bill Owens, *Lifting the Fog of War*, 14, 15. Robert Leonhard seems to argue along similar lines in asserting an inverse proportionality between "knowledge" and "ignorance." See *Principles of War for the Information Age* (Novato, CA: Presidio Press, 1998), 251.
[15] For further discussion See Owens, *Lifting the Fog of War* and Stuart E. Johnson and Martin C. Libicki (eds.) *Dominant Battlespace Knowledge* (Washington DC: National Defense University Press, 1996).
[16] Hugh Courtney, Jane Kirkland, and Patrick Viguerie, "Strategy Under Uncertainty," Harvard Business Review (November/December 1997). Reproduced in *Strategy and Force Planning*, 3rd Edition (Newport, RI: Naval War College Press, 2000), 37-41.
[17] The interactions and counteractions and the resulting changes and adaptations that take place create such complexity that the interacting systems defy modeling by anything less complex than themselves.
[18] Courtney *et al*, "Strategy under Uncertainty," 43-51. The authors suggest three strategic postures: shape the future, adapt to the future, and reserve the right to play; and three payoff profiles in a portfolio of action: no-regrets moves, options, and big bets.
[1] Owens, *Lifting the Fog of War*, p. 14-5. Owens defines battlespace awareness as the "senior commander's overall comprehension of the enemy, how his own forces, the battlefield terrain, and any other factors that will influence the course of battle. It rests on advanced sensing and reporting technologies and includes both platforms and sensors we associate with intelligence gathering."
[2] See the essays in Stuart E. Johnson and Martin C. Libicki, *Dominant Battlespace Knowledge*. Washington DC: National Defense University, 1996.
[3] Martin C. Libicki, "DBK and Its Consequences," p. 24 (emphasis in original).
[4] Jeffrey Cooper, "DBK and Future Warfare," p. 89.
[5] See John Boyd, "Patterns of Conflict." Lecture to Naval War College, June 1984, and "Conceptual Spiral," Seminar with the Joint Military Operations Faculty, Naval War College, August 1990. See also Grant Tedrick Hammond, *The Mind of War: John Boyd and American Security*; and William S. Lind, *Maneuver Warfare Handbook*, pp. 4-8; and Robert R. Leonhard, *The Art of Maneuver*, pp. 50-52.
[6] See Boyd, "Patterns of Conflict" and "Conceptual Spiral." For the best discussions of maneuver warfare see Lind, *Maneuver Warfare Handbook*; Leonhard, *The Art of Maneuver*; and Richard D. Hooker, *Maneuver Warfare: An Anthology*.
[7] Roche and Watts, "Choosing analytic Measures," p. 169; Herman Kahn, "On the Possibilities for Victory or Defeat," p. 180. Robert McQuie, "Battle Outcomes: Casualty Rates as a Measure of Defeat," p. 33: "No matter how casualties are measured, battles have been given up as lost when casualties ranged from insignificant to overwhelming... The outcome of battle modeled by the Lanchesterian equations postulates

a development of combat in response to casualties incurred. During the last 50 years, however, battles appear to have been resolved largely on the basis of other considerations."

[8] Some scholars even argue that "information suppression" operations can "shatter an enemy's will to resist and force it to sue for peace." See Mahnken, "War in the Information Age," p. 42.

[9] Plato's Myth of the Cave is an example of bounded rationality. According to Plato, we do not see things as they really are. As individual bound by chains in a cave with our backs to the lights, we see only images and shadows of things represented on the wall of the cave. Plato did suggest, however, that a philosopher could break the chains of perception and turn around, climb out of the cave, and reach the light. From there, he could see things as they really are. See Book VII in Bloom, *The Republic of Plato*. See also Aeschylus, *Prometheus Bound*.

[10] For a discussion of Cognitive Maps see Klein, *Sources of Power*, p. 289.

[11] Ephriam Kam, *Surprise Attack*, p. 37.

[12] See Kam, p. 105; Slovic, Fischoff, and Lichtenstein, "The Certainty Illusion," p. 14-15; Watts, p. 76-77.

[13] Judgmental heuristics are general inferential rules we use to categorize and classify information and determine its representativeness and predictive value. See Slovic, *From Shakespeare to Simon*, p. 10; Tversky and Kahneman, "Availability: A Heuristic for Judging Frequency and Probability," p. 207, and "Judgment under Uncertainty: Heuristics and Biases," p. 1124; Nisbett and Ross, *Human Inference: Strategies and Shortcomings of Social Judgment*, p. 7; and Kam, p. 106-112.

[14] Holsti, p. 12; Klein, *Sources of Power*, p. 289; Kam, p. 86-7.

[15] For relevant studies see Ken Booth, *Strategy and Ethnocentrism*; Robert Jervis, *Perception and Misperception in International Politics*, and *The Logic of Image in International Relations*; Herbert Goldhamer and Joan Goldhamer, *Reality and Belief in Military Affairs*; John W. Dower, *War Without Mercy*; Maoz, *Paradoxes*, p. 326; Kam, p.2.

[16] Heuristics are general inferential rules from which we assess meaning and predictive value of information.

[17] Tversky and Kahneman, "Availability," p. 208; "Judgment under Uncertainty," p. 1127;Kahnemen and Tversky, "Variants of Uncertainty," p. 163-178; Shelley Taylor, "The Availability Bias in Social Perception and Interaction," p. 191-7.

[18] Peter L. Bernstein, *Against the Gods*, p. 272. See also Amos Tversky, "Psychology of Risk," in William F. Sharpe (ed.), *Quantifying the Market Risk Premium Phenomenon for Investment Decision-Making*, p. 75.

[19] Rebecca Wohlstetter, *Pearl Harbor*, p. vii.

[20] Kahneman and Tversky, "Subjective Probability: A Judgment of Representativeness," p. 431; Tversky and Kahneman, "Judgment under Uncertainty," p. 1126; Baruch Fischhoff, "Attribution Theory and Judgment under Uncertainty," p. 431; Frank Stech, *Political and Military Estimation* , p. 315; Kam, p. 108-110.

[21] Kam, p. 92, 126; Heuer, "Improving Intelligence Analysis," p. 7-8; Jervis, *Perception and Misperception in International Politics*, p. 228-9.

[22] See, for instance, Milton Bearden, "Afghanistan, Graveyard of Empires."

[23] For discussions of the Soviet experience in Afghanistan see Lester W. Grau, ed. *The Bear Went over the Mountain: Soviet Combat Tactics in Afghanistan*; Lester W. Grau and Ali Ahmad Jalali, *The Other Side of the Mountain: Mujahideen Tactics in the Soviet-Afghan War*; Scott R. McMichael, *Stumbling Bear: Soviet Military Performance in Afghanistan*; Henry S. Bradsher, *Afghanistan and the Soviet Union*; and M. Hassan Kakar, *Afghanistan: The Soviet Invasion and the Afghan Response, 1979-1982*. For further source material see the website by Frederick W. Kagan: www.dean.usma.edu/history/afghanweb/Default.htm.

[24] For a discussion of the so-called "Peace Ballot" in Britain in the interwar period see Donald Kagan, *On the Origins of War and the Preservation of Peace*, pp. 341-2, 347. For a similar analysis in a contemporary American context see Donald Kagan and Fred Kagan, *While America Sleeps*, pp. 246-256, 340, 424-429. According to a CNN/USA Today/Gallop Poll taken in December 1995, the majority of Americans disapproved of military actions in places such as Somalia, Haiti, and Bosnia, and that fear of casualties in such efforts were important considerations in their disapproval. By contrast, after the September 11 attacks, as many as 90% of the American people polled supported military action, and large percentages of the population were willing to accept American casualties in the War on Terrorism. See the USA Today/CNN/Gallup Poll results, 12-13 September 2001; 16-19 October 2001; 2-4 November 2001; and 14-16 December 2001.

[25] Tversky and Kahneman, "Judgment under Uncertainty," p. 1128-9; Slovic, Fischhoff, and Lichtenstein, "Cognitive Processes and Societal Risk Taking," p. 172; Kam, p. 111-2.
[26] Werner De Bondt and Richard H. Thaler, "Does the Stock Market Overreact?" pp. 793-807.
[27] Kam, p. 112; James Leasor, *Singapore: The Battle that Changed the World*, pp. 15, 123-6.
[28] John Cohen, *Behaviour in Uncertainty*, p. 142.
[29] Maoz, p. 326.
[30] Kam, p. 112; Koriat, Lichtenstein, and Fischoff, "Reasons for Confidence," p. 108,111; Nisbett and Ross, 1980, p. 119; Slovic, Kunreuther and White, "Decision Processes, Rationality, and Adjustment to Natural Hazards," p. 195; Slovic, Fischoff, and Lichtenstein, "The Certainty Illusion," p. 17.
[31] Kam, p. 55; Freedman,*U.S. Intelligence and the Soviet Strategic Threat*, p. 62-73; Gazit, "Estimates and Fortune-Telling in Intelligence Work," p. 18.
[32] Kam, p. 9, 51; Barry Turner, "The Organizational and Interorganizational Development of Disasters," p. 378-396; Michael Handel, "The Yom Kippur War and the Inevitability of Surprise," p. 461-501.
[33] Roger Beaumont, *War, Chaos, and History*, p. 49; Kam, p. 98; Jervis, *Perception and Misperception*, p. 145-7, 154, 172; Joseph De Rivera, *The Psychological Dimensions of Foreign Policy*, p. 40-1.
[34] Kam, p. 85. See also p. 48-9.
[35] Kam, p. 48-9; 100; Klaus Knorr, "Failures in National Intelligence Estimates: The Case of the Cuban Missiles," p. 462; Beaumont, *War, Chaos, and History*, p. 70.
[36] 1-3) Kam, p. 90; Nisbett and Ross, p. 169; 4) Kam, p. 93; Nisbett and Ross, p. 180; Slovic and Lichtenstein, "Comparison of Bayesian Apporaches to the Study of Information Processing in Judgment," p. 105.
[37] See, for example, Williamson Murray, "Combined Bomber Offensive," p. 73-94 and "German Response to Victory in Poland: A Case Study in Professionalism;" Timothy Travers, *The Killing Ground*; Andrew Krepinevich, *The Army in Vietnam*; Robert Allan Doughty, *The Breaking Point* and *Seeds of Disaster* to name but a few examples.
[38] Kam, p. 92; Smoke, *War: Controlling Escalation*, p. 284.
[39] Kam, p. 54; Heuer, "Do You Think You Need More Information?" and Stuart Oskamp, "Overconfidence in Case-Study Judgments." As the Commander of Operations Group at the Army's National Training Center, Brigadier General Mark Hertling witnessed first hand how commanders coped with increased information afforded by digital technology. Hertling saw evidence of data overload in some commanders, but also observed, "The more IT played a role, the more confused commanders got." In an information-rich environment, staff and commanders showed a paradoxical lack of rigorous analysis. Some commanders continued to increase the demands for information even though they already had more than they could handle at the time. Interview with Brigadier General Hertling, 27 December 2001.
[40] Kahneman and Tversky, "Advances in Prospect Theory: Cumulative Representation of Uncertainty," pp. 297-323.
[41] See, for instance, David Alberts, "The Future of Command and Control with DBK," pp. 77-81.
[42] Johnson and Levis, "Introduction," in *Science of Command and Control: Coping with Uncertainty*, p. vii; and A.E.R. Woodcock, "Indicators and Warnings as an Input to the C3 Process," in *Science of Command and Control*, p. 33.
[43] Levis and Athans, "The Quest for a C3 Theory: Dreams and Realities;" Maoz, 149.
[44] Thomas C. Schelling, *The Strategy of Conflict*, p. 4.
[45] Alexander George, *Presidential Decisionmaking*, p. 68.
[46] De Rivera, p. 28; Schelling, p. 208; Kam, p. 64-5, 72.
[47] Kam, p. 67-70.
[48] Knorr, "Foreign Intelligence and the Social Sciences," p. 16; Knorr and Morgenstern, "Political Conjecture in Military Planning," p. 12-14; Chuyev and Miklaylov, *Forecasting in Military Affairs: A Soviet View*, p. 41, 50-1; Clausser and Weir, *Intelligence research Methodology*, p. 41, 295; Knorr, "Threat Perception," p. 112; Freeman and Job, "Scientific Forecasts in International Relations," p. 130; Sarbin, "Prolegomenon to a Theory of Counterdeception," p. 154-7; cited in Kam, p. 116-7.
[49] Edward Smith, "The Navy RMA Transformation Wargame Series, April 1995-November 1996," p. 30.
[50] Wallace J. Thies, *When Governments Collide*, p. 323.
[51] Thies also points out that studies of the Suez and Skybolt crises have shown the difficulty of understanding what motivates officials in capitals as familiar as London and the order of magnitude increase in complexity when dealing with a regime like the one in Hanoi (p. 347).

[52] "*Die Truppenführung*" (Troop Leadership), *Chef der Heeresleitung*. Berlin, 1933, p. 1.
[53] David Bohm and David F. Peat, *Science, Order and Creativity*, p. 53.
[54] Heuer, "Strategies for Analytical Judgment," p. 26-7; Kam, p. 137-8; Jervis, *Perception and Misperception*, p. 291.
[55] Kam, p. 89. See De Rivera, p. 28; Geller and Pitz, "Confidence and Decision Speed in the Revision of Opinion," p. 199; Jervis, *Perception and Misperception*, p. 176-7; Slovic, Fischhoff and Lichtenstein, "Rating the Risks," p. 39; Nisbett and Ross, p. 10; Ross, "The Intuitive Psychologist and His Shortcomings," p. 370.
[56] Kam, p. 87, 94, 98; Heuer, "Cognitive Factors in Deception and Counterdeception," pp. 39-40; Robert Axelrod, "Schema Theory;" Steinbrunner, p. 67, 101-2; Robert Axelrod, "How a Schema is Used to Interpret Information," p. 227-8; Bonham, Shapiro, and Trumble, p. 4; Heuer, "Memory: How Do We Remember What We Know?" p. 17-20; Nisbett and Ross, p. 7; Finlay, Holsti and Fagen, *Enemies in Politics*, p. 30.
[57] Kam, p. 101-4. 1) Jervis, *Perception and Misperception*, p. 29; Janis and Mann, p. 125-6; 2) Finlay, Holsti, and Fagen, p. 33-4; 3) George and Smoke, p. 574; Nisbett and Ross, p. 169; 5) De Rivera, p. 79-82; Janis and Mann, p. 129; 6) Jervis, *Perception and Misperception*, p. 188, 294; 7) Jervis, *Perception and Misperception*, p. 294-5; 8) Jervis, *Perception and Misperception*, p. 294-5; Bonham, Shapiro, and Trumble, p. 11; 9) Jervis, *Perception and Misperception*, 295-6; Snyder and Diesing, p. 314; Bonham, Shapiro, and Trumble, p. 11.
[58] Kam, p. 93.
[59] Wohlstetter, p. 226.
[60] For an argument to the contrary see Thomas K. Adams, "Future Warfare and the Decline of Human Decision-Making," pp. 57-71.

Chapter Five
[1] For some accessible studies of Game Theory see Priscilla Murphy, "Game Theory Models for Organizational/Public Conflict;" David D. Friedman, *Price Theory: An Intermediate Text*. Cincinnati, OH: South-Western Publishing, 1990.
http://www.daviddfriedman.com/Academic/Price_Theory/Pthy_Chapter_11.html; Morton D. Davis, *Game Theory: a Nontechnical Introduction*; Priscilla Murphy, "Game Theory: A New Paradigm for the Public Relations Process," in Carl Botan and Vincent Hazleton (eds.), *Public Relations Theory*; Howard Raiffa, *The Art and Science of Negotiation*; and Martin Shubik, *Game Theory in Social Sciences: Concepts and Solutions*.
[2] Friedman, p. 1.
[3] The following three games are derived from examples in Friedman.
[4] Ardant du Picq, *Battle Studies*, p. 136.
[5] Schelling, *Strategies of Conflict*, p. 57.
[6] See also the discussion in Schelling, *Strategies of Conflict*, pp. 16-8.
[7] Maoz, p. 24.
[8] Schelling, *Strategies of Conflict*, p. 4-5.
[9] Klein, *Sources of Power*, p. 20.
[10] Maoz, p. 328.
[11] Schelling, *Strategies of Conflict*, p. 201-7.
[12] Bernstein, *Against the Gods*, p. 273.
[13] Luttwak, Strategy, p. 58-9.
[14] See the argument by Thomas K. Adams, "Future Warfare and the Decline of Human Decisionmaking."
[15] Bernstein, *Against the Gods*, p. 232.
[16] Adams, "Future Warfare," p. 64.
[17] For another readable discussion of game theory see Morton D. Davis, *Game Theory: A Nontechnical Introduction*. New York: Basic Books, 1983.
[18] Schelling, *Strategies of Conflict*, p. 201. For a very interesting study of the decision-making process in the US government in the aftermath of the September 11, 2001 terrorist attacks see Bob Woodward and Dan Balz, "We Will Rally the World," "Afghan Blueprint Emerges," and "At Camp David, Advise and

Dissent," *Washington Post*, January 28, 29, and 31, 2002. The studies are part of a series entitled, "10 Days in September: Inside the War Cabinet."
[19] Graham Allison and Philip Zelikow, *Essence of Decision*, p. 3; Maoz, p. 19; Kam, p. 67; George, *Presidential Decisionmaking*, p. 67-8.
[20] Bernstein, p. 265.
[21] Robin M. Hogarth and Howard Kunreuther, "Decision-Making under Uncertainty: The Effects of Role and Ambiguity," in Frank Heller, ed. *Decision-Making and Leadership*, p. 191, 227; Beaumont, *War, Chaos, and History*, p. 101; Richard Lazarus, *Psychological Effects of Stress and the Coping Process*, p. 208; Johnathan B. Evans, "Psychological Pitfalls of Forecasting," p. 258-9; Daniel Pick, *War Machine: The Rationalization of Slaughter in the Modern Age*, p. 11.
[22] Iklé, p. 17-37; Cimbala, *Clausewitz and Chaos*, p. 3, 10-11; Watts, *Clausewitzian Friction*, p. 83-85; Beaumont, *War, Chaos, and History*, p. 82.
[23] Beaumont, *War, Chaos, and History*, p. 119-20.
[24] Klein, *Sources*, p. 17, 57, 103.
[25] Allison and Zelikow, p. 5.
[26] Ibid., p. 380-1.
[27] Cimbala, *Clausewitz and Chaos*, p. 10. See also Krepinevich, *The Army in Vietnam*, for discussions of gaps between policy goals and bureaucratic outputs in Vietnam.
[28] Bernstein, *Against the Gods*, p. 203.
[29] Kam, 162-175; 176-198.
[30] Allison and Zelikow, p. 6.
[31] Ibid., p. 382.
[32] Ibid.
[33] Ibid., p. 383.
[34] Doughty, *The Breaking Point*, pp. 236-8. See also Macksey, *Guderian: Panzer General*, pp. 106-114; and Guderian, *Panzer Leader*, pp. 102-110.
[35] Interview with Hermann Balck, 13 April 1979, p. 6.
[36] For examples see Morris H. DeGroot, *Optimal Statistical Decisions*; Peter C. Fishburn, *Decision and Value Theory*; Gary Klein, *Sources of Power*; Edith Stokey and Richard Zeckhauser, *A Primer for Policy Analysis*; Howard Raiffa and Robert Schlaifer, *Applied Statistical Decision Theory*; Ik-Whan Kwon, *Statistical Decision Theory with Business and Economic Applications: A Bayesian Approach.*
[37] John S. Hammond et al, *Smart Choices*, p. 110.
[38] For further discussion see David G. Chandler, *The Campaigns of Napoleon*, pp. 762-790; Owen Connelly, *Blundering to Glory: Napoleon's Military Campaigns*, pp. 158-167; Leo Tolstoy, *War and Peace*, pp. 107-111.
[39] Joint Vision 2020 defines information superiority as "the capability to collect, process, and disseminate an uninterrupted flow of information while exploiting or denying an adversary's ability to do the same." *JV 2020*, p. 8.
[40] Guderian spent most of the day with the 1st Panzer Division, his main effort. His visibility on what was happening across the Corps and particularly behind the French lines was limited. Lafontaine, by contrast, had a better picture of the fight across his front and where the Germans were applying the most pressure, as evidenced by the counterattacks he ordered on the evening of 13 May and the morning of 14 May. His information of important details was hampered by the fact that German aerial and artillery bombardment had cut communication wire in various parts of the division. See Doughty, *The Breaking Point*, pp. 166-201.

Chapter Six

[1] For descriptions of the battle see Stephen M. Rusiecki, *The Key to the Bulge*, pp. 83-105; Stephen Ambrose, *Citizen Soldiers*, pp. 192-195; John Eisenhower, *The Bitter Woods*, pp. 184-194; MacDonald, *A Time for Trumpets*, pp. 174-179; Kingseed, "Heroism Under Fire," pp. 171-174.
[2] Personal reconnaissance of the terrain in June 1998 and June 1999.
[3] See Brower and Dardis, pp. 32-41.
[4] Clausewitz, p. 120.
[5] Anthony Kellett, *Combat Motivation*, p. 309, cited in Brower and Dardis, p. 33.

[6] John Keegan has argued in *Face of Battle* that leaders deeply fear the loss of control of their own forces and particularly the outbreak of panic. See the discussion, pp. 237-282.
[7] Keegan, *Face of Battle*, p. 248. See also the superb discussion in Richard Holmes, *Acts of War*, pp. 136-175.
[8] The moral struggle of man versus himself is articulated powerfully in J. Glenn Gray, *The Warriors: Reflections on Men in Battle*. An interesting anecdote from the battle of Agincourt is the refusal of Henry IV's soldiers to carry out his order to massacre prisoners taken from the battle. See Keegan, *Face of Battle*, p. 268.
[9] S.L.A. Marshall, *Men Against Fire*, p. 44-5.
[10] Keegan, *Face of Battle*, p. 258.
[11] See Brower and Dardis, p. 37.
[12] Grossman, p. 43; Richard Gabriel, *No More Heroes: Madness and Psychiatry in War*. Keegan argues that during the Second World War ten percent of the fighting force was psychologically disabled within the very first hours of battle (p. 280-1).
[13] Madden, p. 58.
[14] Shabtai Noy, "Combat Psychiatry: The American and Israeli Experience," in Belenky, ed., p. 70.
[15] Cited in Keegan, Face of Battle, p. 275.
[16] See also Brower and Dardis, p. 39.
[17] See Grossman, p. 43-50, Brower and Dardis, p. 39.
[18] Grossman, p. 50.
[19] See Dower, *War Without Mercy*; Sledge, *With the Old Breed*; Bartov, *The Eastern Front, 1941-45: German Troops and the Barbarization of Warfare*.
[20] E.B. Sledge, *With the Old Breed*, cited in Brower and Dardis, p. 40.
[21] Brower and Dardis, p. 40.
[22] Lord Moran, p. 61.
[23] J. Glenn Gray, *The Warriors: Reflections on Men in Battle*, p. 13-4.
[24] Keegan, *Face of Battle*, p. 248; Brower and Dardis, p. 33-35.
[25] Flavius Arrian, *Anabasis Alexandri* (Campaigns of Alexander), VI. viii. 3 (Citations of classical texts are by book, section, and paragraph number. Some works, such as Caesar's, do not contain section numbers.).
[26] Caesar, IV. 25.
[27] Kellett, 314.
[28] Bass, "Stress and Leadership," in Heller, p. 139.
[29] Grossman, p. 143.
[30] Brower and Dardis, p. 40; Grossman, p. 143.
[31] Personal conversation with Lyle Bouck in 1999.
[32] Story is cited in Grossman, p. 148.
[33] Grossman, p. 142, 147.
[34] Clausewitz, p. 101.
[35] Ibid., p. 102.
[36] Ibid., p. 102-112.
[37] For a superb study see Terry A. Wolff, "The Operational Commander and Dealing with Uncertainty," School of Advanced Military Studies, US Army Command and General Staff College, Fort Leavenworth, KS, 1991.
[38] General William T. Sherman, *Memoirs Volume II*, pp. 153-4.
[39] Ibid., p. 165.
[40] Basil H. Liddell Hart, *Sherman: Soldier, Realist, American*, p. 284.
[41] S.L.A. Marshall, p. 42.
[42] Henderson, *Cohesion*, p. 22-3; Alexander George, "Primary Groups, Organization, and Military Performance," *The Study of Leadership*, p. 19-3; Ardant du Picq, *Battle Studies*, p. 180.
[43] Gray, *Warriors*, p. 40.
[44] Edward Shils and Morris Janowitz, "Cohesion and Disintegration in the *Werhmacht* in World War II," *Public Opinion Quarterly* 12 (1948), p. 281; cited in Henderson, p. 5. For further studies see Farrell, "Culture of Confidence;" and Robert J. Schneider, "Stress Breakdown in the *Wehrmacht*: Implications for Today's Army."
[45] S.L.A. Marshall, p. 42-3, 141; Grossman, 141, 149-155.

[46] Remarque, *All Quiet On the Western Front*, p. 186.
[47] Marshall, p. 146-9.
[48] Gray, *Warriors*, p. 112.
[49] Clausewitz, p. 119; Cimbala, *Clausewitz and Chaos*, p. 2.
[50] Marshall, p. 92-3.
[51] Ardant du Picq, p. 252.
[52] Henderson, *Cohesion*, p. 4; John H. Johns, et al, *Cohesion in the US Military*. Washington DC: NDU Press, 1984, p. 9. See also Robert W. Madden, "Living on the Edge."
[53] Henderson, p. 109; Madden, "Living on the Edge." At the same time, lack of leadership can allow primary group influences to militate against organizational goals (Henderson, p. 6).
[54] See Kolenda, "Discipline," p. 81.
[55] Lord Moran, *Anatomy of Courage*, p. 162-3; Ardant du Picq, *Battle Studies*, pp. 252-5; Kolenda, "Discipline;" Henderson, p. 107.
[56] Beaumont, War... p. 124.
[57] DA PAM 350-2, *Developing and Maintaining Unit Cohesion* (Washington D.C.: U.S. Government Printing Office), cited in Robert W. Madden, "Living on the Edge: Building Cohesion and the Will to Win," in Kolenda, 60.
[58] Shabtai Noy, p. 78.
[59] Henderson, p. 109.
[60] Doughty, *The Breaking Point*, p. 164.
[61] The recount of the battle is taken from Doughty, *The Breaking Point*, pp. 162-4. See also Guderian, *Panzer Leader*, pp. 97-111. The analysis is also a result of personal reconnaissance of the battlefield by the author in 1997 and 1998.
[62] Marshall, p. 143.
[63] Doughty, *The Breaking Point*, pp. 219-220.
[64] Ibid., p. 220.
[65] Cited in Ibid., pp. 222, 237.
[66] The description of events and quotations are taken from Doughty, *The Breaking Point*, p. 218-224. Doughty, however, does not analyze the problematic issue of initiative in either this or the preceding case. For further discussion see Guderian, *Panzer Leader*, pp. 97-111; and Kolenda, "Between Decision and Action: Leadership at the Critical Moment," and Kolenda, "Discipline."
[67] Doughty, p. 236-8.

Chapter Seven
[1] Linda P. Beckerman, "The Non-Linear Dynamics of War," *Science Applications International Corporation*, 1999. www.belisarius.com/modern_business_strategy/beckerman/non_linear.htm, p. 2.
[2] Alan Beyerchen, "Clausewitz, Nonlinearity and the Unpredictability of War," p. 62.
[3] James Clerk Maxwell, "Science and Free Will," in Lewis Campbell and William Garnett, with a new Preface and appendix by Robert H. Kargon, *The Life of James Clerk Maxwell* [1882], p. 440-2. Quoted in Beyerchen, "Clausewitz, Nonlinearity and the Unpredictability of War," p. 64. See also, Roche and Watts, p. 194; Coe and Dockery, p. 22; Watts, "Clausewitzian Friction," pp. 105-123.
[4] See also Roche and Watts, p. 194.
[5] See Glenn E. James, p. 17.
[6] See also Watts, p. 119-120.
[7] Beyerchen, "Clausewitz, Nonlinearity and the Unpredictability of War," p. 66.
[8] Samuel Huntington, *Clash of Civilizations*, p. 254.
[9] I will capitalize "C" when referring to Chaos as a science and use the lower-case when referring to disorder. For an excellent introduction into Chaos theory see James Gleick, *Chaos: Making a New Science* (New York: Viking Press, 1988) and Glenn E. James, "Chaos Theory: the Essentials for Military Applications." *The Newport Papers #10* (Newport: Naval War College, College of Naval Warfare Studies, 1996).
[10] Weather patterns are examples. We know that temperatures are higher in the summer than in the winter, we know when hurricane and monsoon seasons begin and end, we know when snowfall is likely and when it is not. Within those large parameters, however, we cannot predict with certainty exactly when the hurricane will hit and where, the temperature on a specific day a month in advance, or how many inches of

snow will fall on a given ski resort on a given day two weeks from now. See James Gleick, *Chaos: Making a New Science* (New York: Viking Press, 1988), 48.
[11] A military organization with low morale and capability, for instance, can collapse completely when attacked by a more effective force. Likewise, a change in leadership can alter the morale of an organization radically.
[12] Every input and interaction affects the system. Some are absorbed and the system returns to normal, some alter the system permanently. A robust, or resilient, system is stable; it retains its character in the face of input. A fragile system is unstable – it alters fundamentally due to input.
[13] The Chaotic nature of human systems is due, in part, to the complexity of the individuals that comprise it, the complexity of interactions among individuals, the inputs external to the organization, and the responses and adaptations, individually and collectively, to those inputs and interactions
[14] See Glenn E. James, "Chaos Theory: the Essentials for Military Applications" for a very readable and useful discussion of Chaos Theory.
[15] See James, "Chaos Theory."
[16] As Bernstein argues, "Thus, forecasting tools based on nonlinear models or on computer gymnastics are subject to many of the same hurdles that stand in the way of conventional probability theory: the raw material of the model is the data of the past" (*Against the Gods*, p. 334.).
[17] See also Bernstein's critique in *Against the Gods*, pp. 332-4.
[18] Historian Alan Beyerchen argues that for Clausewitz unpredictability in war results from interaction, friction, and chance. See Beyerchen, "Clausewitz, Nonlinearity and the Unpredictability of War," p. 72-82; also "Imagery," p. 3.
[19] Clausewitz, p. 77.
[20] Ibid., pp. 80, 184-5.
[21] Ibid., p. 75; Beyerchen, "Clausewitz, Nonlinearity and the Unpredictability of War,"p. 67; see also "Clausewitz, Nonlinearity, and the Importance of Imagery,"p. 2.
[22] Clausewitz, p. 119.
[23] Ibid., p. 87.
[24] Ibid., p. 81; Beyerchen, Clausewitz, Nonlinearity, and the Unpredictability of War, p. 68.
[25] Clausewitz, p. 87.
[26] Ibid., p. 89.
[27] Beyerchen, "Clausewitz, Nonlinearity and the Unpredictability of War,"p. 69-70. As Beyerchen points out, Clausewitz was a man of "considerable scientific literacy," and might very well have seen a demonstration of a pendulum and three magnets. See Paret, *Clausewitz*, p. 310.
[28] Clausewitz, p. 89.
[29] Beyerchen, "Clausewitz, Nonlinearity and the Unpredictability of War,"pp. 70-71.
[30] Clausewitz, p. 154.
[31] For a discussion of French doctrine see Doughty, *The Breaking Point*, pp. 27-30; and *Seeds of Disaster*.
[32] Doughty, *Breakout*, pp. 112-130; 197-200.
[33] For a detailed discussion of the French fight at the Meuse and the problems of soldiers fleeing or hiding in their bunkers see Doughty, *The Breaking Point*, pp. 166-201.
[34] Quoted in Ibid., p. 192
[35] See Ibid., p. 197-200 for details of panic in the French infantry.
[36] Ibid., pp. 239-40.
[37] Ibid., p. 255.
[38] Quoted in Ibid., p. 265.

Chapter Eight
[1] See Maoz, p. 21-4. As he explain with paradoxes in war, "The importance … is not that they recur all of the time; it is that they have severe ramifications" (p. 24).
[2] For a similar analysis of friction see Stephen J. Cimbala, *Clausewitz and Chaos*, pp. 200-1.
[3] By "meaningful inputs" I mean inputs to the system that require decisions from leaders and actions from organizations. The level of importance of the inputs is determined by the degree to which they affect the combatants.
[4] See Watts, p. 79.

[5] See, for instance, the study by Fred Charles Iklé, *Every War Must End*, "... the final outcome of wars depends on a much wider range of factors, many of them highly elusive – such as the war's impact on domestic politics or the degree to which the outside powers will intervene" (p. 1-2).
[6] See "In Praise of Hayek," *The Economist*, 28 March 1992, p. 75. Quoted in Watts, p. 70.
[7] F.A. Hayek, in *The Collected Works of F. A. Hayek*, ed W. W. Bartley III, vol 1, *The Fatal Conceit: The Errors of Socialism*, p. 14. Cited in Watts, p. 70.
[8] Hayek, p. 77, cited in Watts, p. 71.
[9] Watts, p. 76. John Boyd argued that the "orientation" process of the OODA loop is shaped by genetic heritage, cultural tradition, previous experiences, and unfolding circumstances. I have subsumed these issues and more under the rubrics of cognitive maps and perceptual lenses.
[10] I have seen many examples of such discontinuities at the Army's combat training centers. A typical criticism is that commanders and staffs routinely fail at predictive analysis because they do not interpret "indicators" correctly. The observer-controllers often feed information from higher intelligence sources to the army unit to exercise the process of predictive analysis. Knowing the enemy's plans, the observer-controllers often gaze in wonder at how the commanders and staff process and interpret the information and make assessments that are completely at odds with what the "indicators" should show. The meanings of the indicators are obvious to the observer-controllers because they have the whole story and they have foreknowledge of the enemy's plans. The player unit, without benefit of such foreknowledge, and subject to the frictions of stress, interprets and processes the information in a way that is indeed reasonable according to their cognitive maps and perceptual lenses in the context. It just so happens that their predictions of the future are often completely incorrect.
[11] Stephen Ambrose, *Citizen Soldiers*, p. 193.
[12] Doughty, *Breakout,* p. 220.
[13] Hayek, p. 71; "Unintended consequences," in Hayek's words, "are paramount: a distribution of resources is effected by an impersonal process in which individuals, acting for their own ends (themselves also often rather vague), literally do not an cannot know what will be the net result of their interactions." Cited in Watts, p. 72.
[14] Daniel C. Dennett, *Darwin's Dangerous Idea: Evolution and the Meanings of Life*, p. 97. See also Watts, p. 73.
[15] Cited in Watts, p. 80. Charles Darwin, *Origin of the Species by Means of Natural Selection*, in *Great Books of the Western World*, Robert Maynard Hutchins, ed. Vol. 49. Chicago: Encyclopaedia Britannica, 1952. p. 239; see also Ernst Mayr, *The Growth of Biological Thought: Diversity, Evolution, and Inheritance*, pp. 394-534.
[16] Cited in Watts, p. 81. Richard Dawkins, "Darwin Triumphant: Darwinism as a Universal Truth," in Michael H. Robinson and Lionel Tiger, eds., *Man and Beast Revisited*, p. 38; Richard Dawkins, *The Blind Watchmaker: Why the Evidence of Evolution Reveals a Universe Without Design*, p. 317.
[17] See the observations of Charles Darwin, *The Origin of Species*, p. 197.
[18] For an introduction to evolutionary biology and adaptive complexity see Ernst Mayr, *Populations, Species, and Evolution*, pp. 1-10; George Gaylord Simpson, *The Major Features of Evolution*, pp. 160-168.
[19] Linda P. Beckerman, "The Nonlinear Dynamics of War," p. 3.
[20] Ibid., p. 4-5. See Mark Bowden, *Black Hawk Down: A Story of Modern War*.
[21] See Gordon and Trainor, pp. 443-461.
[22] Cited in Roche and Watts, p. 185. See also Ronald H. Spector, *Eagle Against the Sun*, p. 154.
[23] Roche and Watts, p. 185; see also Admiral Edwin T. Layton with Captain Pineau and John Costello, *And I Was There: Pearl Harbor and Midway – Breaking the Secrets*, p. 387.
[24] Cited in Roche and Watts, p. 186. See Layton, p. 387.
[25] Cited in Roche and Watts, p. 188.
[26] Wesley F. Craven and James L. Cate. *The Army Air Forces in World War II, Volume III.* Chicago, 1951., *The Army Air Forces in World War II*, Vol 3, pp. 754-5. Cited in Roche and Watts, p. 174.
[27] Roche and Watts, 175; John Kenneth Galbraith, *A Life in Our Times*, p. 206.
[28] Cited in Roche and Watts, 176; John Kenneth Galbraith, *A Life in Our Times*, p. 226.
[29] Cited in Roche and Watts, p. 175; Richard J. Overy, *The Air War 1939-1945*, p. 205-6.
[30] Williamson Murray, "The Combined Bomber Offensive," p. 14.
[31] Roche and Watts, p. 180-1; Burton H. Klein, *Germany's Economic Preparations for War*, pp. 232-3
[32] Murray, "The Combined Bomber Offensive," p. 14-15.

[33] Ibid., p. 16.
[34] Ibid., p. 17.
[35] See interview with Joachim Peiper, 7 September 1945, pp. 14-16.
[36] Estimates of how long Bouck's platoon held up the Germans are contested. Arguments range from 18 to 24 hours on the high end to 8 hours on the low end. Peiper arrived at the Café at Lanzerath around midnight. Clearly Peiper expected them to be much further forward than they actually were and expected to attack on 17 December from a position far deeper into American lines than he was forced to do. Peiper began planning the attack on the mythical American position at 0100. He began his attack at 0400, only to find no opposition along the route to Honsfeld. Peiper received a call from his division at 0800, he had been out of contact with them since the 16th, asking him why he had not begun his attack. This is a clear indication that the division and corps expected Peiper to be much further along by daybreak on the 17th, As events during Peiper's attack reveal, the delay was enough for American engineers to blow bridges literally in Peiper's face and eventually bottle him up between blown bridges near La Gleize, Belgium. See interview with Peiper, pp. 14-16. See also Rusiecki, pp. 83-105, 153-157; Kingseed, p. 174; MacDonald, pp. 178-9, 188-244.
[37] Watts, p. 47-8; Michael R. Gordon and Bernard E. Trainor, p. 304, 371, 376; Robert Scales, Jr., *Certain Victory: The United States Army in the Gulf War*, pp. 216-223; Richard M. Swain, *"Lucky War": Third Army in Desert Storm*, pp. 230.
[38] Watts, p. 49.
[39] Personal interview with Barry R. McCaffrey, 14 January 2002.
[40] Swain, *Lucky War*, p. 238.
[41] In the assessment of one observer, "Schwarzkopf did not know where his leading forces actually were." John H. Cushman, "Desert Storm's End Game," p. 76; Watts, p. 49.
[42] Gordon and Trainor, pp. 404, 422-425; George Bush and Brent Scowcroft, *A World Transformed*, pp. 484-6
[43] See James G. Burton, "Pushing Them Out the Back Door," pp. 37-42.
[44] Central Intelligence Agency, Office of Imagery Analysis, "Operation *Desert Storm*: A Snapshot of the Battlefield," IA 93-10022, September 1993. Cited in Watts, p. 49. On 2 March the US 24th Infantry Division (Mechanized) destroyed at least 39 tanks and 52 other armored vehicles of the Republican Guard's *Hammurabi* Division when the latter initiated a firefight during its retreat to the Hawr al Hammar causeway.
[45] Michael R. Gordon and Bernard E. Trainor, pp. 427-432.
[46] Watts, p. 51. See also John H. Cushman, "Back to the Gulf," p. 35; David A. Flugham, "Iraq Invasion Threat Reassessed by Military," p. 18-19. Between 3 and 9 October 1994, Iraq positioned roughly 70,000 troops and over 1000 tanks, including two Republican Guards Divisions, on Kuwait's northern border. The US deployed approximately 14,000 soldiers to the Gulf in response.
[47] The US forces ran a number of simulations prior to the Gulf War in order to assess the likely outcome of the war and use the simulated outcomes to make adjustments to plans. According to Barry R. McCaffrey, the simulations constantly had the coalition losing to Iraq because it failed to account for qualitative disparities. For another superb study of the criticality of the qualitative edge in the Gulf War, see Stephen Biddle, "Victory Misunderstood: What the Gulf War Tells Us about the Future of Conflict," pp. 139-179.
[48] Interview with senior officers on the Joint Staff in the Pentagon, 27 December 2001.
[49] At the same time, a large presence of US ground forces in the region, it was feared, might have led to anti-American hostility among the Afghan people. In retrospect, it seems that such fears were exaggerated. Nonetheless, the response of Afghans to use ground presence was yet another uncertainty in the conflict that could not be rectified by information technology.
[50] Marc Kaufman and Peter Baker, "U.S. Mistakes Cost Innocent Lives, Afghan Leader Says," *Washington Post* (February 6, 2002); Michael Ware, "How the U.S. Killed the Wrong Soldiers," *Time* (February 11, 2002); John F. Burns, "Villagers Add to Reports of Raids Gone Astray," *New York Times* (February 2, 2002); Vernon Loeb and Bradley Graham, "Rumsfeld Says U.S. Raid May Have Killed Allies," *Washington Post* (February 5, 2002); and Carlotta Gall and Craig S. Smith, "Afghan Witnesses Say G.I.s Were Duped in Raid on Allies," *New York Times* (February 27, 2002).
[51] Smoke, *Controlling Escalation*, p. 108.
[52] Beaumont, *War, Chaos, and History*, p. 119.

[53] See the important studies by Maoz; Luttwak, *Strategy*, pp. 20, 47-9, 92-97, 208-230, 236; Beaumont, *War, Chaos, and History*, p. 106.
[54] Levis and Athens, p. 5-6. "Attempts to generalize the simple cybernetic loop ... by introducing nested processes has led very rapidly to the 'Achilles heel' of systems engineering: the curse of dimensionality. A simple argument shows that the number of interconnecting links in such expanded representations as (#of processes)^2 X (#of stages)^2. By then, the simplicity and elegance – the strengths – of the cybernetic loop have been lost." For an argument that suggests the contrary, that war is simply a matter of processing power, see Adams, "Future Warfare."

Chapter Nine

[1] Interview with BG Mark Hertling, Vice J-7 of the Joint Staff, 27 Dec 2001.
[2] Karl Vick, "In a Desert Outpost, the Afghan War was Won," *Washington Post* (December 31, 2001); see also Rowan Scarborough, "Karzai, A Team Turned Tide of War," *Washington Times* (January 22, 2002); Thom Shanker, "Conduct of War is Redefined by Success of Special Forces," *New York Times* (January 21, 2002); Kirk Spitzer, "Green Berets Outfought, Outthought the Taliban," *USA Today* (January 7, 2002).
[3] See the interesting articles about Chinese development see Timothy L. Thomas, "Behind the Great Firewall of China: A Look at RMA/IW Theory from 1996-1998," Foreign Military Studies Office Publication, Fort Leavenworth, KS, November 1998. http://www.call.army.mil/call/fmso/fmsopubs/issues/chinarma.htm; and Stokes, Mark A. "China's Military Space and Conventional Theater Missile Development: Implications for Security in the Taiwan Strait," in Susan M. Puska, ed. *People's Liberation Army After Next*. Carlisle, PA: Strategic Studies Institute, US Army War College, 2000.
[4] Doughty, *Breakout*, pp. 224-230.
[5] For further development see Kolenda, "What is Leadership," "Discipline," "Between Decision and Action," and "Navigating the Fog of Technological Change;" see also Walter F. Ulmer, Jr. "Introduction," and Lute, "Looking Up," in Kolenda (ed.), *Leadership: the Warrior's Art.*
[6] Guderian, *Panzer Leader*, p. 108 (Doughty records the passage in *Breakout*, p. 236, but mistakenly cites it as coming from pp. 85-6 in Guderian.). This particular engagement was with the French 3rd Spahi Brigade. Balck claimed that they were the "best troops" he faced in both wars. "They fought like devils. They had to be dug out of their entrenched positions. The brigade commander and one of the two regimental commanders were killed; the other regimental commander was severely wounded and captured. Only a dozen officers survived; the remainder died" (Interview with Hermann Balck, 13 April 1979, pp. 6-7.
[7] Clausewitz, p. 100.
[8] Ibid., p. 101.
[9] Ibid., p. 112.
[10] Clausewitz regards obstinacy as a fault of temperament (p. 108). This is in part true in terms of the inability to accept criticism or tolerate contradiction. It can also be an intellectual deficiency resulting from failing to develop a capacity for coping with conflicting information and assessments. Inability to handle ambiguity and complexity is a function of poor intellectual development.
[11] Ibid., p. 102.
[12] Ibid., p. 106.
[13] Ibid., p. 107.
[14] Ibid., p. 108.
[15] See Mao, "On Protracted War," p. 243; Handel, *Masters of War*, p. 250-1; Jomini, *Art of War*, p. 274.
[16] For further development see Gulick and Martin, p. 12; Kam, p. 232-3; George Wright, Fergus Bolger, and Gene Rowe, "Judgment and Decision-Making," p. 223; R.M. Hogarth, *Judgment and Choice: The Psychology of Decision.*
[17] Luttwak, p. 13.
[18] For a discussion of how experts learn see Klein, *Sources of Power*, p. 104.
[19] Cited in Cimbala, *Clausewitz and Chaos*, p. 10.
[20] *JV2020*, p. 8
[21] Ibid., pp. 3, 8.
[22] Ibid., pp. 8, 10.

[23] See Cimbala, *Clausewitz and Chaos*, p. 11. "Van Creveld's study of Command in War is in fact an argument for skepticism that the essence of command can be improved even if the technology of command becomes more sophisticated and the management of command more complicated."
[24] The French did have significant challenges in situational awareness. In many places the French defenders at Sedan had failed to bury their communication wire, so consequently lines had been cut during the German artillery and aerial bombardments. Nonetheless, the chain of command had enough situational awareness to begin counterattacks beginning in the early evening. See Doughty, *Breakout*, pp. 166-201
[25] For an exceptionally detailed study of the psychological effects of poor cohesion in the French at Sedan see Doughty, *Breakout*, pp. 166-201, esp. pp. 169-171.
[26] See for instance Macgregor, *Breaking the Phalanx*, pp. 59-93; Baynes, *Morale*, p. 253; Balck, "Interview," 13 April 1979, p. 19.
[27] One example from the army is the removal of the fourth company in some armor and infantry battalions. The loss of the company has significantly reduced flexibility at the battalion level. Similarly, the loss of cavalry regiments for army corps has likewise degraded flexibility during transition periods in combat.
[28] For an argument about the futility of doctrine see Beaumont, *War, Chaos, and History*.
[29] See Sun-Tzu, V. 1-4.

Chapter Ten
[1] Ian Stewart, *Does God Play Dice? The Mathematics of Chaos*, p. 83. Quoted in Alan Beyerchen, "Clausewitz, Nonlinearity and the Unpredictability of War," p. 63.
[2] For a critique of ordinary linear logic in military theory see Luttwak, p. 4-5.
[3] See Sun-Tzu, IV. 1-4.
[4] Naval War College Professor Bradford Lee uses this construct for his discussions and course on "Theories of Victory." A theory of victory must address the friendly courses of action, enemy military reactions, strategic effects of the interactions, the enemy political reactions to those strategic effects, and the political endgame of the war. In terms of strategic effects, Lee sees three orders. First order military effects result from the violent interaction of forces. Second order effects can be logistical, economic, psychological, and cognitive – effects on the enemy's command, control and information systems. Arcane effects are the third. These effects can manifest themselves as political impacts on the enemy's regime, inducing strategic blunders as the enemy reacts inappropriately to strategic effects, resource misallocation blunders, "treasure" effects against something held to be dear by the enemy, and coalition effects.
[5] Boyd, "Patterns of Conflict," Slide 176. See also Sun-Tzu's advice to be "without ascertainable shape" (*Art of War*, VI. 24).
[6] Hermann Balck, "Interview," 12 January 1979, p. 22.
[7] For further development see Madden, "Living on the Edge;" Henderson, *Cohesion*; and Kellet, *Combat Motivation*. For a superb discussion of the British Regimental system and its impact on combat effectiveness in the First World War, see Baynes, *Morale*. For a perspective on the German Army in World War Two, see Farrell, "Culture of Confidence," and Balck, interview 13 April 1979, pp. 17-20.

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